

FOREST TREES OF AUSTRALIA

FIFTH EDITION



D.J. Boland, M.I.H. Brooker, G.M. Chippendale, N. Hall, B.P.M. Hyland,
R.D. Johnston, D.A. Kleinig, M.W. McDonald and J.D. Turner

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Revised and enlarged by M.W. McDonald, M.I.H. Brooker,
D.A. Kleinig and B.P.M. Hyland.

Coordinated by M.W. McDonald



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Mountain ash (*Eucalyptus regnans*) with tree fern understorey, Blackspur, Victoria.

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Preface to the Fifth Edition

Forest Trees of Australia has proved to be a popular and successful scientific publication. Over the years it has come to be considered one of the classic texts in Australian forestry and botany.

The first edition was published by the Australian Government Publishing Service (AGPS), Canberra, for the Forestry and Timber Bureau in 1957. The authors were Norman Hall, R.D. Johnston and C.D. Hamilton, and the book described 67 species of *Eucalyptus*. The second and third editions, published in 1962 and 1970 respectively, were compiled by Norman Hall, R.D. Johnston and G.M. Chippendale. An additional 51 species were added to the third edition, including eight non-eucalypt species. In 1975 the Forestry and Timber Bureau became the CSIRO Division of Forest Research, and by 1979 it was decided that the book needed to be extensively revised. Many more species were included and the black and white composite photographic plates illustrating features of interest have become a hallmark of this text. The fourth edition was published in 1984, with D.J. Boland as coordinator, and has been reprinted many times.

This fifth edition is a further revision and enlargement of the book. Since 1980, numerous revisions of the taxonomy have been published for species treated in the fourth edition, particularly for the eucalypts, and new species have been described. In view of recent advances in knowledge of the classification and natural distribution of Australian trees, in 2003 the CSIRO Forestry and Forest Products group decided to begin work on a new edition. This has involved the selection and inclusion of more species, updating of the previous text and distribution maps, and improvements to some of the photographic plates.

As with previous editions, the criteria used to select species were that they should be important to the timber industry, conspicuous in the landscape, of environmental value, or of ornamental interest. Consideration was also given to a range of genera from across the Australian landscape, e.g. for a large genus like *Eucalyptus*, the main species from most Australian States were included. With these criteria a total of 178 eucalypt species and 121 non-eucalypt species have been treated. To the 1984 edition we have added 41 eucalypts and 25 non-eucalypt species.

A special feature of the book is the extensive use of black and white photography to illustrate each species. The majority of the former CSIRO Forestry and Forest Products (now Ensis) photographic plate collection exists in black and white, and extensive use of these historical plates made the task of compiling this new edition straightforward. The plates include the depiction of leaf venation and oil glands taken in the field using natural transmitted sunlight. Fine botanical features not always accessible to the naked eye such as ovule patterns in the dissected flower bud have been illustrated by scanning electron micrographs. For the new species that have been included, special effort was made to raise and photograph seedlings from authenticated seeds, usually collected from naturally growing trees. Most tree photographs were taken within natural stands.

It is expected that this book will be of use to foresters, botanists, horticulturalists, a wide range of students, farmers and to all people interested in our native trees, especially as *Eucalyptus* and *Acacia* in particular, have become of major importance in commercial forestry in other countries. As Australia's CSIRO Forestry and Forest Products group joins with New Zealand's Scion (formerly Forest Research) in a new joint venture, Ensis, the scope of forestry research in the Asia-Pacific region enters a new phase. We hope this new edition of *Forest Trees of Australia* will have a role to play in this new era and will also be of value to anyone with an interest in native Australian trees for many years into the future.

We dedicate this edition of 'Forest Trees of Australia' to Norman Hall and Doug Boland.



Norman Hall (1906–2005) initiated the first edition of *Forest Trees of Australia* in 1957 and was a principal contributor to all subsequent editions of the book. Norman Hall was born in New Zealand in 1906 and graduated in Forestry from the University of New Zealand. He later migrated to Australia. During World War II he served in a Forestry Company, Royal Australian Engineers, and following the war as a forester in Europe. He is known to generations of forestry students and forestry workers, from his first employment in 1937 in the Woods and Forests Department in Mt Gambier, South Australia, to his work in Canberra in the Forestry and Timber Bureau and his lecturing at the Australian National University, and finally in retirement with the CSIRO Division of Forest Research when the 1984 edition was published.



Douglas John Boland (1947–2001) was the coordinator and a major contributor to the enlarged fourth edition of *Forest Trees of Australia*. Doug was born 7 May 1947 at Inverell, New South Wales. He gained a Commonwealth Forestry Scholarship in 1965 and completed a BSc (Forestry) at the University of New England. During his tenure as a Research Scientist with CSIRO he completed a MSc at the Australian National University in 1978, revising the taxonomy of the *Eucalyptus leucoxylon* complex. Doug went on to become an internationally respected specialist in the use of forest genetic resources. During his distinguished career he produced numerous publications on eucalypts, acacias and many other genera, focussing on their taxonomy, characterisation and domestication strategies.

Changes for the Fifth Edition

Sixty-five new treatments incorporating 72 species are presented in this new edition. There are now treatments of 29 acacias and nearly 190 eucalypts, two of the most useful and diverse tree groups in Australia. Treatments of other species of significance, such as Wollemi pine (*Wollemia nobilis*) and beach sheoak (*Casuarina equisetifolia*), have also been included.

The species treatments have been revised throughout. Where appropriate the most recent taxonomic nomenclature has been presented (notes on previous taxonomic status are presented in the *Related Species* section). New distribution maps reflecting the most recent information on geographic occurrence have been presented for each species and most infraspecific taxon. Some images in the black and white plates have been replaced either by a better image or to reflect taxonomic changes.

We have made a number of changes to the format of the species descriptions in order to limit each treatment to a two-page format so that we may accommodate the extra species presented in this edition, while not dramatically affecting the length of the book. The climatic data of each species (including altitude), previously cited as text in the second paragraph of main descriptive text, have been presented in a new *Climate* section that appears before the *Distinctive features* section. We believe this change also improves the clarity and accessibility of these data. We have also combined the information previously given under the separate headings *Type* and *Published* into one section with the new title *Publication*.

In addition, we have omitted the majority of incidental images such as the black and white photographs that often focused on historical aspects of forest trees, and some of the botanical line drawings. In the 4th edition species descriptions often extended to a third page, so such images were used to fill spaces that would otherwise have been blank. While the omitted images may have been of some interest for the reader, we trust the revised format is acceptable, as it has enabled us to greatly expand the number of species treated.

Changes in the Section on Eucalypts

The conflicting generic concepts of Hill and Johnson (1995), who recognised the bloodwoods and ghost gums as a separate genus, *Corymbia*, and Brooker (2000), who recognised *Angophora* and *Corymbia* as subgenera of *Eucalyptus*, were difficult to reconcile for this edition. While there is a general acceptance of the genus *Corymbia* by the botanical scientific community in Australia, its application in other areas is still somewhat controversial. We have given *Eucalyptus sens. lat.* precedence over genus *Corymbia* in this edition, but we have parenthesised the alternative Hill and Johnson *Corymbia* combination under the scientific name for each bloodwood and ghost gum treatment presented. Angophoras have been moved into the eucalypt section to reflect their close phylogeny, but their reduction to subgeneric rank proposed by Brooker (2000) has not been adopted. Where the common name ‘eucalypt’ is used we intend it to also include angophoras and bloodwoods. The eucalypts now appear in a phylogenetic order that follows Brooker (2000).

As the great majority of the eucalypts are lignotuberos, we infer the character to be assumed present in all species unless stated otherwise. If a species is non-lignotuberos it is cited under the *Distinctive features* section. Pith glands are prominent in some large groups but in the majority of eucalypts treated in this edition they are absent. If a species has pith glands this information is also given in the *Distinctive features* section, otherwise they should be assumed absent. Seed descriptions are now provided for each species under the *Fruits* section.

Distribution maps for the eucalypts have been revised based mainly on the Australian National Herbarium Specimen Information Register (ANHSIR) database. This database records information on one of the world's largest collections of eucalypt specimens. As the majority of these specimens were determined or confirmed by M.I.H. Brooker, the new eucalypt maps closely reflect his taxonomic concepts on the geographic occurrence of taxa.

Finally, in the introductory sections for the various groups of eucalypts, the dichotomous keys to species treated in each section have been omitted as they were of limited use for identification purposes. However, a new key to the natural groups of eucalypts has been presented.

Contributions of Each Author

Doug Boland was the coordinator of the fourth edition, in which he authored numerous non-eucalypt treatments and some eucalypt treatments, provided distribution maps, collected field specimens for photographing, took field and SEM images, did the plate design for non-eucalypt treatments and collated the supplementary graphics.

Ian Brooker originally authored and revised much of text in the section on eucalypts in the fourth and fifth editions; he collected field specimens for photographing, took field, SEM and macro leaf venation images; he also wrote the Wollemi pine text in the current edition.

George Chippendale was an author on second and third editions of this book and provided the distribution maps for eucalypts in the fourth edition.

Norman Hall was the senior author on first, second and third editions of this book; his work that was the catalyst for subsequent editions; in the fourth edition he authored text for numerous species, collected field specimens, provided field images and collated all the climate data presented.

Bernie Hyland authored text on the rainforest trees in the fourth edition and revised the text for the current edition; he collected field specimens and provided field images.

Doug Johnston was an author on first, second and third editions of this book; in the fourth edition he authored the much-expanded Introduction (mostly unchanged in the current edition apart from some minor revisions), provided text on non-eucalypt species, collected field specimens and provided field images.

David Kleinig was an author on the fourth edition and provided text in the large section on eucalypts; he collected field specimens for photographing, took field, SEM and laboratory macro images, raised eucalypt seedlings for photographing and did the plate design for the eucalypts. For the fifth edition he reviewed much of the text.

Maurice McDonald coordinated the revision of the fifth edition; he authored text for numerous species treatments particularly the eucalypts and acacias; he collected field specimens and raised seedlings for photographing, took field and laboratory macro images and produced distribution maps for all species presented.

John Turner was an author of text for a number of non-eucalypt species in the fourth edition; he raised seedlings, collected field specimens, took field and laboratory macro images and produced distribution maps.

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We would like to thank the team at Forestry and Forest Products, a former Division of CSIRO, particularly S.J. Midgley, T.K. Vercoe, J.C. Doran, K. Aken, B. Clarke, B. Brammall, C. Doran, C.A. Gardiner, B.V. Gunn, J.S. Larmour, E. Morrow, C. Sinosec, P.A. Butcher, P. Warburton, P. Macdonell, S. Southerton and L. Bulkeley. J.G. Morosin (formerly Forestry and Forest Products) and A.C. Matheson (Ensis) provided invaluable assistance in scanning the original plates. J. Owen (Ensis) provided advice on raising seedlings and A. Winter (Conservation Volunteers Australia) helped produce maps and grow seedlings. We thank J. Croft (CSIRO's Centre for Plant Biodiversity Research) for allowing access to the Australian National Herbarium Specimen Information Register. Readers are referred to many of the people acknowledged in the fourth edition of this book for their valuable contributions that have been carried over into this edition. We are indebted to E.J. Cole (formerly Forestry and Forest Products) for sharing his experience and wisdom, which greatly facilitated the ongoing fieldwork required to complete this book.

A number of images were sourced from archives other than our own and we wish to thank: P. Meagher and J. Plaza (Mt Annan Botanical Gardens and Botanic Gardens Trust Sydney) for making available images of Wollemi pine (*Wollemia nobilis*); the Australian National Herbarium (CSIRO Plant Industry) for use of their colour macro images of leaf venation types of the eucalypts; B.R. Maslin (CALM Western Australia) for a number of excellent images of acacias (and for an image of the elusive *N. Hall*); and O. Strewe (Sydney) who produced a number of the images that have been used.

We are especially appreciative of the time spent by J. Connors, L.A. Craven (CSIRO Plant Industry), J. Ilic (formerly Ensis), D. Nicolle (Adelaide), A. Specht (Southern Cross University), L.A.J. Thomson (formerly Ensis) and anonymous reviewers used by CSIRO Publishing, in reviewing various sections of the draft manuscript, which in some sections must have been a formidable task. D. Nicolle allowed access to unpublished manuscripts and specimens from his arboretum. We also thank J. Connors and A. Slee (CSIRO Plant Industry) for discussions on aspects of the taxonomy of the genus *Eucalyptus*, and B.R. Maslin (CALM Western Australia) for similar discussions regarding the taxonomy of *Acacia*.

Finally we would like to acknowledge Ann Crabb (formerly CSIRO Publishing) whose enthusiasm and professional expertise ensured that a fifth edition would see the light of day and Briana Elwood (CSIRO Publishing) who facilitated the process.

Book Structure—Explanatory Notes

Order of Presentation of Families, Genera and Species

The species treated in this book are divided into three major groups. The first group contains the gymnosperms and this is followed by the angiosperms in which the species are further grouped into dicotyledons and monocotyledons. In each of these groups, the families and genera within families are arranged alphabetically by scientific name, except for the four monocotyledon genera in the palm group. Within each genus the species are also arranged alphabetically by scientific name, except for those belonging to the genus *Eucalyptus*. In this case, the species are listed systematically according to the classification of Brooker (2000), with the species arranged by subgenera and then into smaller natural groupings so that related species are next to one another rather than in alphabetical order. The overall arrangement is shown in the Contents. Special introductory sections are provided for each of the major Australian tree genera, viz. *Acacia*, *Banksia*, *Casuarina*, *Eucalyptus*, *Melaleuca* and the palm group. In each section the important features of the genus or group are identified. As the eucalypts are a major part of the book, further descriptions of subgenera and other important natural species groups, e.g. ashes, peppermints, stringybarks and so on, are also given. A key to the natural groupings of eucalypts is provided.

Presentation of Species Descriptions

The descriptions are generally arranged in a two-page format with the text and the map of the species distribution on the left and a composite plate of botanical and tree photographs on the right.

Text

The botanical names of species follow current nomenclature. The nomenclature for the eucalypts mainly follows Brooker *et al.* (2002). The common names for species mostly follow the ‘Nomenclature of Australian Timbers’ (Australian Standard 1970). The main common name is given prominence with alternative names in smaller type.

The text for each species usually follows a basic pattern. The first four paragraphs contain comments on habit, distribution, ecology and associated species. The first paragraph includes a description of a typical tree plus such details as tree height, stem diameter at breast height (dbh), tree form, crown shape etc. An arbitrary scale was used to divide the species into four height groups, i.e. small (less than 10 m), medium-sized (10–25 m), tall (25–50 m) and very tall (greater than 50 m). Tree heights and stem diameters were usually assessed visually.

The second paragraph provides details on the species distribution, often citing specific localities, which may be familiar to readers or readily located using a map or gazetteer.

The third paragraph provides ecological details on the species, including, where applicable, information on site, aspect, parent material and soil. In most instances only the general conditions and not unusual or extreme conditions are indicated. Soil descriptions have been kept simple and generalised. Most provide information on the main textural classes—for more detailed information on Australian soils the reader is referred to Isbell (1996) and McKenzie *et al.* (2004).

The fourth paragraph describes the forest communities in which the species usually occurs. For non-rainforest communities we have broadly followed the classification devised by Specht *et al.* (1970), and for rainforest communities we have used the older more familiar climatic classification, e.g. tropical, subtropical, temperate and so on, followed usually by, in brackets, the structural classification of

rainforests devised by Webb (1968, 1976). An indication is also given of the main species (mostly tree species (referred to generally as ‘associated’) likely to be found in association with or near the species being described.

For some species the third and fourth paragraph may be combined where limited text was required to describe their ecology and associations. Sometimes a fifth paragraph may provide additional general information.

The remaining paragraphs are in smaller print. These cover mainly botanical information, often in abbreviated form. An explanation for each heading in the order that they appear is as follows.

Related species: Information is provided, where appropriate, on the names of closely related species and the key features on how to distinguish them. On some occasions species not closely related but commonly confused with the species under discussion are indicated. For the section on eucalypts, the discussion follows Brooker (2000), as this is the most recent species-level classification published (see pp. 201–202 for a discussion). This replaces the classification of Pryor and Johnson (1971), that was used in the 4th edition. Where appropriate, various other studies are referred to in this section and these are cited in the References section.

Publication: The publication for the original description of each species name is given. This is provided for completeness so that the reader can examine an original description if necessary. The titles of the publications are abbreviated in the manner recommended (with small changes) by Stafleu and Cowan (1976–1987) for books and Lawrence *et al.* (1968) for periodicals and journals. All abbreviations of the names of authors of species follow Brummitt and Powell (1992).

Where known, the location and collector(s) of the type specimen(s) are also given. A type specimen is usually cited or designated by the author as the main reference specimen used to typify the name of the species. Type specimens are critical if a taxonomic revision or name change for a species is necessary. Such studies use type specimens to reference and validate new taxonomic names. This information is considered useful in that any major variant observed in a natural population can be referred to the standard for the species (the type) for comparison. This aids overall understanding of the range of variation within the particular species in question.

Names: The meanings of the generic and specific names are given. These usually, but not always, involve a translation from either Greek or Latin words. The names often allude to features that characterise particular genera and species. The reason for the main common name is given if known. In some cases the common names used for eucalypts may not reflect the common names used in higher order groupings. For example, despite its common name ‘Queensland peppermint’, *Eucalyptus exserta*, which has peppermint-scented leaf oils, belongs in the ‘red gum group’ (subgenus *Symphomyrtus*, section *Exsertae*) not with the true peppermints (subgenus *Monocalyptus*, section *Aromatica*). Many common names given to eucalypts were coined based on their most conspicuous field character rather than their phylogeny.

Bark: Notes on the texture and colour of the bark are provided. For some rainforest species the characteristics of the blaze, i.e. the colour determined from a slash made on the tree trunk by an axe or knife are also given.

Leaves: This section is divided into features of the cotyledons, seedling and adult leaves but some information has been omitted when not pertinent. Juvenile and intermediate leaves commonly occur in a number of groups, particularly eucalypts and some acacias, and these are described where appropriate. Nearly all seedlings for these descriptions were raised from seeds collected from natural trees and grown in pots in a temperature-controlled glasshouse. Where problems were experienced in either obtaining or germinating seeds we resorted to collecting seedlings found growing in the field. This occurred mainly for a few rainforest species and such specimens are indicated in the captions to the photographic plates.

Inflorescences: Details on the kinds of inflorescences and descriptions of the individual floral organs are given. For the gymnosperms, information on the strobili is given. The normal flowering times, if known, are also presented.

Fruits: Details on the kind of fruit and fruit colour, texture and dimensions are usually given. For eucalypts the information provided is for fruits after dehiscence has occurred. The usual months in which mature fruits can be obtained are given when known. A brief description of diagnostic seed characters is also given. For the gymnosperms, information on the cones is given.

Wood: General characteristics of the sapwood and heartwood, including the *Lyctus*-susceptibility of the sapwood, are given. The densities stated in kilograms per cubic metre (kg m^{-3}) are for wood at 12 per cent moisture content (air dried) because this is the usual moisture content of seasoned timber when marketed. Details of the more common uses of the timber, where known, are also provided.

Climate: A summary of meteorological data that could be useful when considering a species for cultivation are provided. These are based on climate conditions that prevail over the natural distribution of the taxa. Given are:

- **Altitudinal range**—metres above sea level (m);
- **Hottest/coldest month**—the mean maximum of the hottest month and mean minimum of the coldest month ($^{\circ}\text{C}$);
- **Frost incidence**—the incidence or frequency of frosts occurring over the natural range of a species. These are categorised as: *low* = nil or very low incidence of frost throughout range; *moderate* = moderate incidence of frost at least in some years or in some part of the range; *high* = heavy frosts in most years over all or a substantial part of the range;
- **Rainfall**—the mean annual rainfall range (mm) and rainfall seasonality. Rainfall may have a strong seasonal influence and fall predominantly in either winter (winter max.) or summer (summer max.), or may be distributed throughout the year without a strong seasonal pattern (uniform).

The climatic software package by (Houlder *et al.* 2000) was used to generate climatic data for all new species treated and for species where these data warranted revision. Climate data from cultivated stands outside the natural range of a species were not included in analyses.

Distinctive features: Attention is drawn here to the most distinctive characteristics of the species. These features are normally vital for identification of the species.

Photographic plates and maps

The composite black and white photographic plates include field and laboratory macrophotography and sometimes flash photography for leaf venation, and scanning electron micrographs (S.E.M.) of small features of interest, e.g. flowers. For all species an attempt has been made to include photographs of glasshouse-raised seedlings, adult leaves, inflorescences, fruits, bark and tree, together with various extras such as leaf venations, flowers etc., where appropriate. All field photographs are from natural stands (unless otherwise indicated), the locations of which are described in the captions to the plates. Many of these photographs come from the historical collections of CSIRO and are only available in black and white.

The distribution maps are compiled in a 'spot' style. Shaded circles or dots indicate actual collections of species; where more than one taxa are mapped squares, and in some instances triangles are used. In some maps an open circle is used to draw attention to a limited or remote geographic occurrence.



Some Vegetation Types of Australia

1. Closed tropical rainforest, Atherton Tableland, Qld 2. Closed temperate rainforest, Bulga National Park, Vic. (Image: O. Strewe) 3. Closed warm temperate rainforest, near Bodalla, N.S.W. 4. Gallery rainforest, Eungella National Park, Qld



5. Mixed *Eucalyptus*–*Angophora* open forest, near Sydney, N.S.W. 6. Gympie messmate (*E. cloeziana*) open forest, near Herberton, Qld 7. Spotted gum (*E. maculata*)–blackbutt (*E. pilularis*) open forest, Rosedale, South Coast, N.S.W. 8. Karri (*E. diversicolor*) tall open forest, near Margaret River, W.A.



9. Lemon-scented gum (*Eucalyptus citriodora*) open forest Auburn Range, Qld 10. Smooth-barked apple (*Angophora costata*)–blackbutt (*E. pilularis*) open forest, near Woy Woy, N.S.W. 11. Scribbly gum (*E. rossii*) open woodland, near Canberra, A.C.T. 12. Bloodwood (*E.* subgenus *Corymbia*) open savanna woodland, near Dunmarra, N.T.



13. Salmon gum (*E. salmonophloia*) open forest, near Southern Cross, W.A. 14. Gimlet (*E. salubris*) open woodland, Koolyanobbing, W.A. 15. Narrow-leaved ironbark (*E. crebra*)–Brown's box (*E. brownii*) open woodland, Valley of Lagoons, Qld 16. River red gum (*E. camaldulensis*) open woodland, Marshall River, N.T.



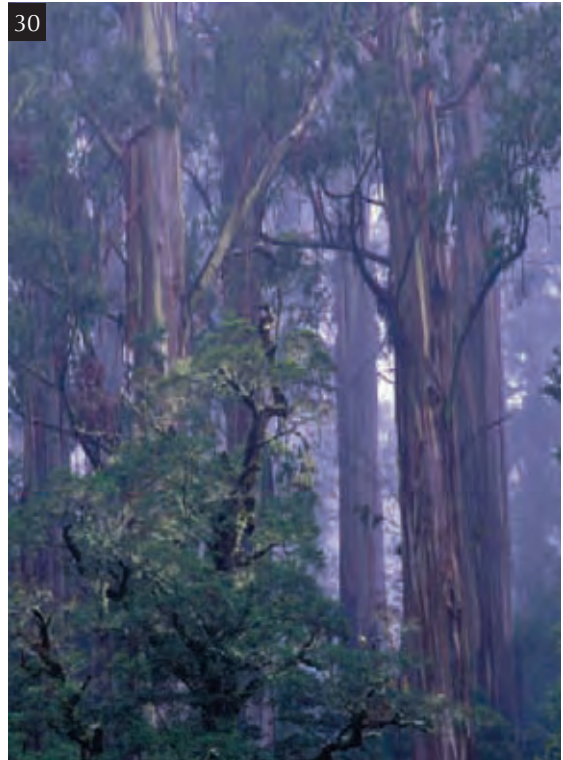
17. Desert oak (*Allocasuarina decaisneana*) open woodland, near Kaltukatjara, N.T. 18. Snappy gum (*Eucalyptus leucophloia*) open woodland, Pilbara, W.A. 19. Open mallee (*Eucalyptus* spp.) shrubland, Eyre Peninsula, S.A. 20. Mulga (*Acacia aneura*)-gidgee (*A. cambagei*) tall open shrubland, Nareen Station, Qld



21. Mulga (*Acacia aneura*) tall open shrubland, near Sandstone, W.A. 22. Western myall (*A. papyrocarpa*) tall open shrubland, near Madura, W.A. 23. Mulga (*A. aneura*) open shrubland with river red gum (*E. camaldulensis*) low open woodland along a creek, near Tibooburra, N.S.W. 24. Baarla (*E. gongylocarpa*) open woodland, Cosmo Newberry, W.A.



25. Sydney blue gum (*Eucalyptus saligna*) open forest, Styx River State Forest, N.S.W. 26. Mixed eucalypt forest Brooyar State Forest, Qld 27. Gimlet (*E. salubris*) open woodland, near Die Hardy Range, W.A. 28. Rib-fruited mallee (*E. corrugata*) open mallee woodland, Die Hardy Range, W.A.



Tall open forests: 29. Mountain ash (*E. regnans*), Bulga National Park, Vic. 30. Shining gum (*E. denticulata*)–blackwood (*Acacia melanoxylon*), Errinundra National Park, Vic. 31. Flooded gum (*E. grandis*), near Bulahdelah, N.S.W. 32. Round-leaved gum (*E. deanei*), Kedumba Valley, N.S.W. (Images: O Strewe)



33. Boab (*Adansonia gregorii*) open woodland, Crystal Creek, Kimberley, W.A. 34. Darwin stringybark (*Eucalyptus tetradonta*)–Darwin blackbutt (*E. miniata*) open forest, Donydji, Arnhem Land, N.T. 35. White cypress (*Callitris glaucophylla*) open woodland, near Boggabri, N.S.W. 36. Coojong (*Acacia saligna*) open shrubland, Sanford River, W.A. 37. Variable-barked bloodwood (*Eucalyptus dichromophloia*) near Pine Creek, N.T. 38. Small-stilted mangrove (*Rhizophora stylosa*) low open woodland, near Coffs Harbour, N.S.W.

39



40



41



42



43



Clearing vegetation for agriculture has resulted in population fragmentation in many species, for example: 39. Sugar gum (*E. cladocalyx*) 40. Merrit (*E. urna*). Mature stands of cultivated native trees are now common throughout many parts of Australia, for example 41. Sydney blue gum (*E. saligna*) plantation near Bridgetown, W.A. 42. Bunya pine (*Araucaria bidwillii*) near Bodalla, N.S.W. (Image: O. Strewe) 43. Macadamia (*Macadamia integrifolia*) plantation, Dunoon, N.S.W.



Some Bark Types of Australian Trees

1, 2. Smooth-barked apple (*Angophora costata*)—the colour of all smooth-barked eucalypts varies with the season and stage of bark shed 3, 4. Spotted gum (*Eucalyptus maculata*)—showing variation in mottling 5. Grey gum (*E. punctata*) 6. Blackbutt (*E. pilularis*)



7. Scribbly gum (*E. racemosa*) 8. Flooded gum (*E. grandis*) 9. White gum (*E. nobilis*) 10. Carbeen (*E. tessellaris*) 11. Sydney blue gum (*E. saligna*) 12. Salmon gum (*E. salmonophloia*)



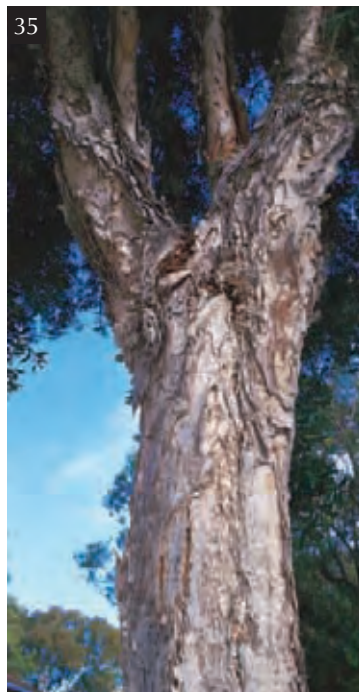
13. Red-flowered mallee (*Eucalyptus erythronema*) 14. Ribbon-barked gum (*E. sheathiana*) 15. Silver-topped gimlet (*E. ravida*) 16. Gimlet (*E. salubris*) 17, 18. River red gum (*E. camaldulensis*)—arid zone form (17), Murray-Darling Basin form (18)



19. Cleland's blackbutt (*E. clelandii*) 20. Red morrell (*E. longicornis*) 21. Gympie messmate (*E. cloeziana*)
22. Green mallee (*E. viridis*) 23. White box (*E. albens*) 24. Blue-leaved stringybark (*E. agglomerata*)



25. Marri (*E. calophylla*) 26. Red ironbark (*E. sideroxylon*) 27. Cooba (*Acacia salicina*) 28. Creekline miniritchie (*A. cyperophylla*) 29. Ironwood (*A. estrophiolata*) 30. Coojong (*A. saligna*)



31. Hoop pine (*Araucaria cunninghamii*) 32. Kauri pine (*Agathis robusta*) 33. Bunya pine (*Araucaria bidwillii*)
 34. White cypress pine (*Callitris glaucophylla*) 35. Five-veined paperbark (*Melaleuca quinquinervia*) 36. Red cedar (*Toona ciliata*)

Introduction

Origin of Australian Trees

A visitor to Australia can only be impressed by the fact that the vegetation is strikingly different from that of countries in the northern hemisphere. In particular forests and woodland dominated by eucalypts and acacias are unique to this country. But further observations show that some formations do have affinities outside Australia. For example, there are strong similarities between the tropical rainforests of Australia and Malaysia, and between the cool temperate rainforest of Tasmania and New Zealand.

In the past, Australia was joined to Antarctica as part of Gondwana during the early Cretaceous period (Fig. 1). This is the period when the flowering plants were evolving, and there is considerable evidence from fossils that, as well as gymnosperms, many elements of the developing angiosperm flora were present on Gondwana by the beginning of the Tertiary, some 65 million years ago.

Because of the breakup of Gondwana, direct migration between South America, Africa and Australia for warm-temperate and subtropical plants was last possible about 100 million years ago. More or less direct migration between Australia and South America via Antarctica may have been possible via elevated areas on the South Tasman Rise until about 85 million years ago (Fig. 2), but is assumed to have been limited to cold-tolerant plants.



Figure 1. Gondwana in early Cretaceous times (135 million years ago): Gymnosperms are well developed and widespread. Development of angiosperm families has begun and migration amongst all the southern continents is possible. Land surfaces of Australia are shown stippled.



Figure 2. Southern continents in Cretaceous times (100 million years ago): Africa, India, New Zealand and South America have separated and Australia is about to separate from Antarctica. This is the last opportunity for the overland entry of Gondwana plants into Australia.

By the mid Miocene (15 million years ago) the Australian plate had moved away from Antarctica and collided with the Asian and Pacific plates in the north (Fig. 3), establishing the first direct path for the migration of plants between Asia and Australia.

The fossil evidence indicates that the flora of southern Australia during the late Cretaceous and early Tertiary was composed largely of forms corresponding to the Antarctic and Indo-Malayan elements mentioned above (Table 1). This flora extended at least to central Australia but unfortunately there is only a sparse fossil record of the Tertiary flora over tropical Australia and the greater part of Western Australia. Pollen and macrofossils of *Banksia* and Casuarinaceae, which were considered to be part of the autochthonous element, have been identified from the lower Tertiary (Oligocene) in Victoria, and fossils of *Eucalyptus*, *Casuarina* and *Banksia* plus fruits like those of *Santalum* and various Proteaceae have been found in inland South Australia, in rocks which have been very tentatively attributed to the lower Oligocene. Other groups, including *Acacia*, do not appear until the late Oligocene–early Miocene.

On the basis of continental movements and the fossil records of plant distribution, it can be postulated that the ancestors of the southern-hemisphere gymnosperm were present in Australia in the Middle Jurassic and that the ancestors of many of our angiosperms spread to Australia from other parts of Gondwana in the Cretaceous and early Tertiary. This influx included constituents of all three major elements, but additional taxa have entered from Asia since the Miocene period, and other more-diverse immigrants have come from various sources.

From a consideration of present distribution and degrees of differentiation shown, estimates have been made of the probable time of entry of various families or their ancestors. Those families which are endemic to Australia, or which have a few species in adjacent regions, are believed to have evolved here from ancestors which were present in the Cretaceous but have since disappeared. Examples are Casuarinaceae, Myoporaceae, Pittosporaceae, Epacridaceae. In Proteaceae the subfamily Persoonioideae is about equally divided between South Africa and southern Australia (with one species of *Persoonia* in northern Australia and one in New Zealand) but the subfamily Grevilleoideae, with 14 Australian endemic genera, is also represented in South-East Asia and South America, and this is interpreted as showing a family origin in Australia or in Antarctica close to Australia, before the



Figure 3. Australia's neighbours in Miocene times (15 million years ago): The Australian plate has moved away from Antarctica and collided with the Asian plate. Migration of plants between Australia and Asia, across a narrow sea barrier, is possible.

separation of Africa from other parts of Gondwana; the spread to South-East Asia is presumed to be post-Miocene. In the family Myrtaceae the dry-fruited subfamilies Leptospermoideae and Chamelaucioideae are centred in Australia—the latter is wholly Australian—but the fleshy-fruited Myrtoideae have major centres in South America and tropical Asia as well as Australia. Early development in Gondwana would explain the South American–Australian distribution. The Asian occurrence may have originated from Australia.

Other families, while not restricted to Australia, may have one or more endemic genera and, if the number of these is taken to indicate the length of time they have been in the region, then Cunoniaceae, Rutaceae, Santalaceae, Escalloniaceae, Monimiaceae and Sterculiaceae were early arrivals. Fossil evidence supports this postulate in the case of the Cunoniaceae and Santalaceae.

In contrast, there are about 30 families that are represented in Australia by a few genera, none of which are endemic, although their Australian species may be. These are apparently relatively recent immigrants; many are confined to northern or north-eastern areas. Examples are Burseraceae, Annonaceae and Myrtistaceae.

Other families, with a few genera endemic to Australia or with non-endemic genera represented by many species, probably occupy an intermediate position. Special mention should be made of mangroves and strand-line trees such as *Terminalia catappa* and *Hibiscus tiliaceus*. These species are evidently dispersed easily between countries and could have entered more than once, independently of other representatives of their families.

Variation and Adaptation of Australian Trees

About one-third of the seed-bearing plant genera in Australia (about 570 genera out of 1700) are endemic and, of these, over 100 are restricted to the south-western province, 86 to the arid zone, 75 to the tropics and 14 to Tasmania.

At the species level this pattern is accentuated. No precise estimates are available but over 90 per cent of Australian species are endemic. In addition to the 570 endemic genera, 270 genera are represented in Australia by endemic species only.

The large number of endemic species and the restriction of many of these to particular regions are evidence of continuing evolution but the pattern of distribution of species is complex. Some have evidently developed from genera, which migrated from Asia after the Miocene. *Terminalia* might be considered a good example; of the 29 Australian species only *T. catappa* occurs in Indonesia, although there are 50 species in the region. Other genera, such as *Casuarina*, undoubtedly have had a much longer period of speciation, but there is no indication of the age of individual species. On the other hand, there is evidence that new species are evolving at present in several other genera.

Although much work has been done to define morphological differences between species, there has been only limited research on the variation within species on a quantitative basis. Within the genus *Eucalyptus*, various studies of individual species (e.g. *E. camaldulensis*) or groups (e.g. *E. globulus* and relatives) have assessed morphological, chemical or physiological attributes. Similar work on a smaller scale has been done for *Acacia*. Fossil evidence for occurrence of *Eucalyptus* earlier than Miocene is inconclusive, but on other indications it is an old genus, differentiated into several subgenera and many species. Many Australian tree species exhibit considerable variation in morphological, chemical and physiological attributes, often in patterns that show correlation with geographic patterns of occurrence. The geographic patterns have been partly formalised by the recognition of provenances, but the delimitation of provenances is not usually explicit. Pattern analysis has shown that for a particular attribute or combination of attributes there may be core areas connected by gradients. This has led to problems in taxonomy, particularly in the definition of species; in some cases the solution appears to be to reduce the status of the intergrading species to subspecies.

Table 1. A geological time scale for the first appearance of some important Australian plant families and genera and the relationship of these events to general changes in Australian climates and landscapes* (Key: K = thousands of years; M = millions of years; NW = north-western Australia; S = southern Australia; SE = south-eastern Australia; NG = New Guinea; NSW = New South Wales; NZ = New Zealand; Qld = Queensland; SA = South Australia; Tas = Tasmania; Vic = Victoria; WA = Western Australia).

Geological time scale			Approx. years before present	Climate
Era	Period	Epoch		
Cainozoic	Quaternary		3K to present	Drier with minor fluctuations
		Recent	3–8K	Wetter, warmer than present
		Pleistocene	10K	End of most recent glacial period
			18K	Very dry, cool, windy
			20K	Peak of last glacial period
			40K	Start of most recent glacial period
			120K	
				Fluctuating warm-cool
		1.8M		Cool, cold
	Tertiary	Pliocene		Seasonal (inland)
		5M		Briefly cold then warmer, wetter
		Miocene		Warm, dry NW; moist SE
				Cool, dry
			15M	Antarctica freezes; Australia dries out
		24M		
		Oligocene		Mild, wet SE; cool westerly air circulation in S; marked drop in temperature
		34M		
		Eocene		Irregular air circulation; warm, wet
		55M		
		Palaeocene		Mild, wet
		65M		
Mesozoic	Cretaceous		80M	
			85M	Weak continental air circulation
			100M	
	141M			
	Jurassic		135M	
			150M	
			180M	Wetter, warm, humid
	205M			
	Triassic			
				Warm, humid
	251M			
Palaeozoic	Permian			Global warming
	298M			
	Carboniferous			Major icehouse phase begins
	Devonian			Warm
	410M			
	Silurian			
	434M			Warm
	Ordovician			
	490M			
	Cambrian			
	545M			

*Information for this table was collated from numerous sources, including Hill *et al.* (1999), McPhail and Hill (2001) and Johnson (2004).

Geological events	First appearance of pollen forms of families and genera
Sea levels rise—most recent separation of Australia from Tas. and NG; sand dunes inland	
Sea levels fall—Tas. and NG joined to mainland; arid zone more extensive than present;	
Glaciation in SE	
Sea levels similar to present	
Sea levels fall	
WA uplift, Vic coastal submergence; Lake Eyre subsides; deserts develop inland	
SA uplift; block-faulting, laterisation	
Shallow seas in south; charcoal rapidly increases in deposits; the widespread forest cover diminishes	Marked increase in Myrtaceae, Poaceae, Asteraceae pollen
	<i>Eucalyptus</i> subgen. <i>Monocalyptus</i> , <i>Symphyomyrtus</i> , <i>Bacchus</i> Marsh, Vic.; <i>Symplocaceae</i> , <i>Asteraceae</i>
Contact with South-East Asia	<i>Nothofagus</i> less common; 2 major eucalypt lineages at Warrumbungle; NSW; <i>Oleaceae</i> , <i>Lauraceae</i>
Bass Strait formed	<i>Acacia</i> established in eastern Australia; <i>Eucalyptus spathulata</i> pollen in Victoria
Shallow seas in south	<i>Acacia</i> established in western Australia; <i>Cupaniaceae</i> , <i>Santalaceae</i>
Commencement of pediplanation	Myrtaceae, Bombacaceae, Euphorbiaceae
Laterisation; cool temperate rainforests in the SE; extinction of dinosaurs, ammonites	Eucalypt-type pollen; <i>Banksia</i> , <i>Casuarina</i> , <i>Olacaceae</i>
Most of Australia thickly forested including rainforest in many parts	
Final separation of Australia from Antarctica; Tasman Sea separates Australia from NZ; lakes in inland Qld., significant sea level changes	Winteraceae, <i>Ilex</i> , <i>Nothofagus</i> , <i>Proteaceae</i> , <i>Eidothea</i> , <i>Anacardiaceae</i> , <i>Cunoniaceae</i> , <i>Lauraceae</i> , <i>Rutaceae</i> , <i>Sapindaceae</i>
The split of Australia from Antarctica begins, inland seas retreat	Flowering plants increase rapidly
Commencement of laterisation	Cupressaceae; earliest known angiosperm pollen
Break-up of Gondwana; possible uplift of eastern highlands; shallow seas in Qld, NSW and WA	Podocarpaceae, <i>Araucariaceae</i> ; Gymnosperm forests dominated by conifers, seed-ferns, bryophytes, ginkgos
	<i>Wollemia nobilis</i> near Gulgong, NSW
	Conifers, cycads
Mass extinction event	
	<i>Glossopteris</i> , a primitive gymnosperm
Intense glacial erosion	First cold-climate vegetation ('Gondwana flora'); appearance of first seed-plants (<i>Nothorhacopteris</i>); lycopods dominate
	Range of lycopods or <i>Baragwanathia</i> flora colonise the edges of rivers and lakes; shrub- to tree-sized lycophytes
	<i>Baragwanathia longifolia</i> , the earliest known Australian lycopod (primitive land plant) found near Yea, Vic.
	First vascular plants
Marine floras	
Accretion of Gondwana	

From an ecological point of view, the recognition of variations within species leads to the question whether each variant is adapted to its particular site or whether variants are only partly adapted over a range of sites which themselves vary both in space and time.

Genetic studies in some species of *Eucalyptus* show that, as well as differences between species and between populations of single species, there is a high degree of genetic variation within populations. This variation in *Eucalyptus* appears to result from high levels of outbreeding (approximately 70–90 per cent) plus lower viability of selfed seed. In spite of this high level of outbreeding, differences between adjacent stands may be maintained by differential selection pressures. For example, in *E. urnigera* in Tasmania there is evidence that correlated gradients in leaf wax, leaf shape, bark texture and timing of growth are maintained over an altitudinal range of about 100 m and a horizontal distance of 2–3 km, by strong selection pressures operating in opposing directions.

Similar studies in many other widespread tree genera such as *Melaleuca*, *Banksia* and *Callitris* have shown comparable patterns of variation. In most genera there is usually a clear demarcation between species and more variation within populations than between populations. The implication is that these species are adapted to particular niches and have high competitive ability in niches that are relatively stable. The high variability within populations produces some progeny suitable for each of a range of sites and can take advantage of changing situations.

Adaptation is, of course, related to all aspects of a plant's environment, but some particular attributes are related to particular features. For example, mangroves are adapted to brief periodic inundation with seawater and have developed mechanisms for excluding salts from their tissues or for excreting them. Because they grow in silty, badly aerated soils with low structural strength, many mangroves have also developed shallow, spreading root systems with emergent pneumatophores, or prop roots. Combinations of morphological and physiological features needed to grow on tidal sites have been developed in species of several unrelated families. In some genera all species are mangroves (e.g. *Rhizophora*) but in others related species occur in rainforests, suggesting that similar adaptations have occurred at different times.

On drier sites, many species show adaptations to periods of drought stress. Seasonal drought in the tropical region is often associated with the deciduous habit, particularly on sites of moderate fertility, where semi-evergreen or deciduous vine thickets occur. Many of the dry-season-deciduous species appear to be post-Miocene immigrants from the Indo-Malayan region, but *Brachychiton* is an endemic Australian genus, with species in rainforests, deciduous vine thickets, open forests and woodlands, one species occurring in low open woodlands in the arid region. All are more or less deciduous, suggesting that this feature may be a relic of past conditions. Several dry-season-deciduous species also have swollen taproots in seedling stages and swollen stems in adult forms, which have been interpreted as adaptations for survival in seasonal drought.

With more extended periods of drought stress in the semi-arid and arid zones, leaves become smaller and thicker, often linear in shape and erect or pendulous rather than horizontal. Phyllode-bearing acacias become the dominant trees over large areas, the eucalypts being relegated to specific sites such as watercourses.

Adaptation to temperature stresses is more common in physiological than morphological attributes, although the narrow, vertically-arranged foliage so common in inland species reduces solar heating and increases convectional cooling. Most resistance appears to be physiological but there is evidence that wax coating of leaves and stems is in some cases an adaptation to frost. The low altitude of the tree line in Australia and the poor survival of Australian tree species in northern hemisphere winters indicate that adaptation to cold is not well developed. This is to be expected in a country with a generally mild climate. Low light intensities throughout northern hemisphere winters probably also inhibit the growth of most Australian trees.

Similarly, few Australian trees show adaptation to wind; most species are deformed by wind-shearing in exposed alpine or coastal situations. Of course, some of the deformation on coastal sites must be the effect of salt spray. *Araucaria cunninghamii*, *Banksia integrifolia* var. *integrifolia* and *Casuarina equisetifolia* are examples of species that are able to grow as upright, symmetrical trees on windswept coasts.

On the other hand, most Australian trees outside the rainforests are well adapted to fire, with attributes such as thick bark, epicormic buds, lignotubers, rhizomes and root-shoots. Many species have woody fruits that protect the seeds from fire and are dependent upon, or stimulated by, fire to release their seed. Others have hard seeds that are stimulated to germinate by heat. In some of these, such as acacias, the seeds are collected and buried by ants, surviving for many years and germinating only after hot fires.

Few rainforest trees are fire-resistant and the boundaries between rainforest and open forest are often determined by fire frequency; rainforests are rarely dry enough to burn but trees on the margins may be killed by scorching. *Callitris glaucophylla* on the other hand, has evolved in a semi-arid climate, where fires are frequent, but it has limited ability to recover from fire injury. *Callitris* has been able to survive in a fire-prone region because it forms relatively dense stands on sandy soils, where the sparse ground cover will not normally carry fire.

The vast majority of Australian soils are very infertile, either because the parent rocks (e.g., siliceous sandstones) are low in nutrient minerals or because the present soils are the products of very long periods of leaching, wind-sorting and erosion. In many areas, phosphate availability is further reduced by the high concentrations of aluminium and iron. Consequently, much of the flora has become adapted to low nutrient levels; nitrogen-fixing plants such as legumes and casuarinas are common and nutrient-conserving strategies such as internal recycling have been developed. Some species have also developed growth habits which appear to enable the seedlings to build up a large root system and accumulate nutrient stocks before the aerial shoot is extended, e.g. *Eucalyptus marginata* and *Acacia peuce*.

There are fairly extensive areas of calcareous soils in Western Australia and South Australia and the tolerance of particular species to high soil calcium has been recognised for some time. Differences in calcium tolerance have been demonstrated between provenances of *Eucalyptus camaldulensis*; field occurrences of other species suggest similar differences but these have not yet been shown experimentally.

Kinds of Trees—Some Important Australian Families

This section describes features of some important Australian plant families of which representative species are treated in this book. The descriptions include two additional families which are not represented by species, but which nevertheless warrant discussion, namely Euphorbiaceae and Pittosporaceae. The families within the major groups gymnosperms and angiosperms are arranged alphabetically with the exception of the three closely related families Caesalpiniaceae, Fabaceae and Mimosaceae, which are treated together in the following discussion.

Gymnosperms

The name gymnosperm is derived from the Greek and means naked seed. The gymnosperms consist of conifers and their allies. They are plants whose ovules and seeds are unprotected and open to the atmosphere rather than enclosed in fruits. Ovules are borne on the surface of megasporophylls. Both the micro- and megasporophylls (stamens and carpels) are usually arranged in cones.

In number of species, the gymnosperms are poorly represented in Australia. Only two of four orders, Cycadales and Coniferales, are present and, in Coniferales, only families Podocarpaceae,

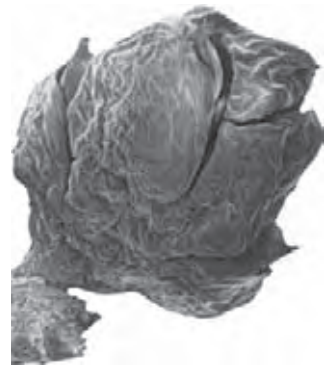
Araucariaceae, Cupressaceae (includes Taxodiaceae in the broad sense). The Podocarpaceae produce their seeds singly, in clusters or small cones, each seed with a fleshy aril, bract or swollen stem (the shrubby *Microstrobos* is exceptional in producing cones with four to eight thin scales). *Podocarpus* is the most widespread genus in the family; there are nine Australian species, with the greatest concentration in northern Queensland but with an extension to Western Australian open forests and to alpine sites in Tasmania and the south-eastern part of the mainland. The leaves of *Podocarpus* species are linear to oblong, from 1 to 25 cm long. Seeds are borne singly above a swollen fleshy stalk, which is usually brightly coloured. *Phyllocladus* is represented in Australia by a single species, *P. aspleniifolius*, restricted to Tasmania; its leaves are reduced to scales but the twigs are flattened to form rhomboidal cladodes. Seeds are borne singly or in clusters, on the edges of the cladodes, each with white aril on a pink fleshy bract. *Lagarostrobos franklinii* (syn. *Dacrydium franklinii*) is the sole Australian representative of the genus and is also restricted to Tasmania. It has tiny scale-like leaves and tiny cones with four to eight fleshy scales, with one or more seeds each in a fleshy aril.

Araucariaceae produce large woody cones which generally disintegrate when the seeds are ripe—*Araucaria bidwillii* cones fall whole and can be rather dangerous. *Araucaria* has awl-shaped or lanceolate, sharply pointed leaves; its seeds are united with the cone scale. There are three Australian species: *A. bidwillii* has sharply pointed lanceolate leaves and large cones (up to 30 cm long) with large, wingless seeds; *A. cunninghamii* has narrow leaves, cones about 10 cm long and seeds with two approximately equal wings; and the recently discovered ‘living fossil’ *Wollemia nobilis* has decurrent, rounded leaves in 4 rows and globular to broadly ellipsoidal cone to 12.5 cm long and circumferentially winged seeds. *A. bidwillii* is confined to Queensland but *A. cunninghamii* extends from northern New South Wales to New Guinea, while *W. nobilis* is known from only one gorge in the Wollemi National Park. Each of the former two species occupies a position in each of the two major groups of araucarias: *A. bidwillii* in section Colymbea, where the adult leaves are flat and the cotyledons remain below ground level; and *A. cunninghamii* in section Eutassa, where the adult leaves are awl-shaped and the cotyledons are projected above ground level upon germination. *Agathis* also occurs in Queensland; there are three Australian species, all with elliptical leaves with blunt tips and one-winged seeds, which are free from the cone scales. *Wollemia nobilis* has characters that exclude it from either of the two major extant groups of araucarias.

The Cupressaceae and the Taxodiaceae are lumped together by some authors. These groups are well represented in the northern hemisphere, with such spectacular trees as the redwoods (*Sequoia* and *Sequoiadendron*) and swamp cypresses (*Taxodium*). The only Australian species considered to belong to the Taxodiaceae by some botanists are



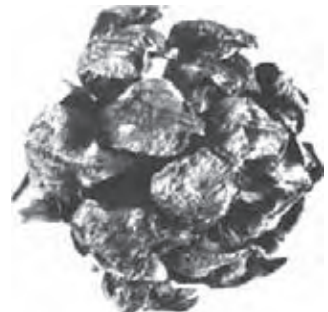
Podocarpaceae
(*Podocarpus elatus*)



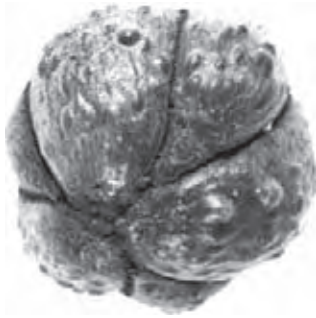
Podocarpaceae
(*Phyllocladus aspleniifolius*)



Araucariaceae
(*Araucaria bidwillii*)



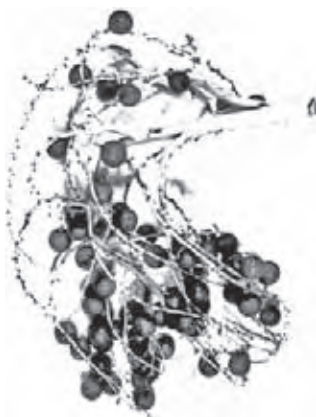
Cupressaceae
(*Athrotaxis selaginoides*)



Cupressaceae
(*Callitris preissii*)



Cupressaceae
(*Callitris macleayana*)



Arecaceae (*Livistona australis*)

from the genus *Athrotaxis*, which has three species in Tasmania. They have spirally arranged leaves, scale-like and closely pressed to the twig in *A. cupressoides* but longer and spreading in *A. selaginoides*, while *A. laxifolia* is intermediate in shape. The cones of this genus consist of 12–25 spirally arranged scales on a short axis, with up to 6 seeds per scale. Other Australian Cupressaceae genera comprise species that have small cones with up to eight woody scales or valves in one or two whorls. The valves spread to release the seeds but the cones remain on the tree for some years. *Callitris*, the most important Australian genus in this family, has two whorls of usually three valves of unequal size (except *C. macleayana* where all valves are of equal length). Most species have small, scale-like leaves but *C. macleayana* produces needle-shaped juvenile leaves on parts of the mature crown. *Callitris* is widespread in Australia except in alpine areas, usually on sandy soils of low fertility. All species are susceptible to fire injury and regenerate from seed. *Actinostrobus* and *Diselma* are shrubby genera; the fruits of *Actinostrobus*, with two species in Western Australia, have a single whorl of six valves of equal size. Tasmanian *Diselma archeri*, the only species in this genus, has cones made up of two pairs of scales, the upper pair with two three-winged seeds.

Angiosperms

The name angiosperm is derived from the Greek and means seed in a vessel. The angiosperms are plants in which the ovules are enclosed within an ovary, and the micro- and megasporophylls are borne in flowers. Plants belonging to angiosperms are divided into two groups on the basis of their having one (the monocotyledons) or two (the dicotyledons) cotyledons per seedling.

Monocotyledons

Relatively few of the significant forest trees of Australia are monocotyledons. Palms represent a relatively unusual group of plants because they are tree-like monocotyledons. Because of differences in anatomy, particularly the lack of a cambium layer to produce secondary thickening of the stem and the limited potential for branching, monocotyledons have markedly different architecture from either dicotyledons or gymnosperms. Arecaceae (formerly Palmae) is the most notable palm family in Australia that has tree size species. Palms characteristically have a single slender cylindrical stem surmounted by a crown of large feather- or fan-shaped leaves, large inflorescences of small cream or pale coloured flowers and fruits varying from small, single-seeded, fleshy fruits (e.g. dates) to large nuts such as the coconut. They are important commercially and for domestic use overseas but have scarcely been used in Australia. Bamboo and *Pandanus* are other monocotyledon species may also reach tree size. Bamboo is very important in Asia, but there are few species native to Australia and these are limited in natural distribution to the tropical regions.

Dicotyledons

The vast majority of Australian forest trees are dicotyledons, representing a wide range of families. Apocynaceae is a widespread family, well represented in tropical and subtropical regions, with a few temperate species. Several genera of lianes occur in Australia, including species in rainforests, open forests and woodlands, with one species in Tasmania (as well as a coastal shrub, *Alyxia buxifolia*) and a few species in south-western Australia. Several genera are represented by shrubs, while *Ochrosia* and *Alstonia* have tree species in tropical regions, with *Alstonia constricta* extending to western New South Wales. Many species of Apocynaceae have milky sap. The leaves are opposite or whorled, simple, entire, without stipules or with small, gland-like stipules on the stem or petiole. The flowers are regular, with five sepals, five corolla-lobes and five stamens attached to the tube of the corolla. The ovary normally consists of two separate carpels, which in the fruit form a pair of follicles opening along the inner edge. These follicles may be 30 cm long in *Alstonia*. In other genera, including *Ochrosia*, the carpels are united to form a brightly coloured drupe.

The family Bombacaceae is strongly represented in Africa and South America, but in Australia we have only one species of *Bombax*, in deciduous vine forests, and one of *Adansonia*, in open woodlands of the Kimberley region. Both species are deciduous; they have digitate leaves, large flowers and fruits and, in *Adansonia*, grotesquely swollen stems.

The families Caesalpiniaceae, Fabaceae and Mimosaceae (together called the Leguminosae in some classifications) are a large group of species containing plants that produce fruits in the form of legumes (monocarpellate pods which normally split along both edges, although some forms are fleshy or break into segments).

Caesalpiniaceae is a mainly tropical family, represented in Australia by *Lysiphyllum*, *Erythrophleum* and *Senna*. The *Lysiphyllum* species and *Erythrophleum chlorostachys* occur in tropical open forests, woodlands and savannah woodlands, while *Senna* has many species ranging from desert shrubs to rainforest trees.

Fabaceae is very large, widely distributed and contains the pea-flowered plants, which are mainly herbaceous. Many Australian species are shrubs, which form an important component of the vegetation (with acacias), with ability to fix atmospheric nitrogen. The main Australian tree genera in Fabaceae are: *Castanospermum*, with a single rainforest species, *C. australe*; *Erythrina* which is represented in Australia by *E. vespertilio*, widespread in the tropical and subtropical regions; and *Barklya*, with *B. syringifolia* in the rainforests of Queensland. A few other genera such as *Jacksonia* and *Sesbania* have species, which reach small tree size.

Mimosaceae is widespread particularly in species of *Acacia*. The acacias are generally smaller than the eucalypts and, where they occur together, usually form a lower layer of trees or shrubs in the vegetation. *Acacia* species are found in rainforests as well as in open forests, but are



Apocynaceae
(*Alstonia scholaris*)



Bombacaceae
(*Adansonia gregorii*)



Caesalpiniaceae
(*Erythrophleum chlorostachys*)



Fabaceae
(*Castanospermum australe*)



Mimosaceae (*Acacia salicina*)



Casuarinaceae
(*Casuarina glauca*)



Cochlospermaceae
(*Cochlosperm gillivraei*)



Combretaceae
(*Terminalia platyphylla*)

common in the drier inland regions of Australia where they are often the dominant trees. Trees in the family Mimosaceae have numerous showy stamens, which are free in *Acacia* but are united basally in *Albizia* and *Pithecellobium*, forming a tube around the ovary. *Albizia* is a genus of mainly African and Asian trees and shrubs; many of them are deciduous. The Australian species, occurring in Western Australia, Queensland and the Northern Territory, include valuable timber trees. *Archidendron* species occur in the tropical and subtropical rainforests and produce very showy flowers.

Casuarinaceae is a ubiquitous Australian family with representatives as well in the tropical region from Malaysia to Fiji. Without close relatives although possibly related to Hamamelidaceae, it has three genera, *Allocasuarina*, *Casuarina* and *Gymnostoma*, which show reduction of the leaves to scales or toothed sheaths surrounding the twigs, male flowers to single stamens and female flowers to single carpels clustered in cone-like heads. Species of *Casuarina* occur from the sea-shore to mountains and deserts and from the tropics to southern Tasmania. This is one of Australia's few families of wind-pollinated trees other than conifers.

Cochlospermaceae is a tropical family with three genera of trees and shrubs that have lobed leaves, deciduous in the dry season, and large showy flowers. The Australian species of *Cochlospermum* occur on seasonally dry sites in the tropical regions, from northern Queensland to the Kimberley region of Western Australia. The bright yellow flowers are produced while the small trees are leafless. Flowers are regular, with five sepals and petals, numerous stamens and an ovary of five fused carpels which develops into a relatively large capsule, enclosing numerous black seeds with a mass of white cotton-like fibres. The bark of *Cochlospermum* contains tough fibres; the wood is soft and brittle.

The family Combretaceae is distributed throughout the tropics but most genera are confined to specific regions, only *Combretum* and *Terminalia* being pantropical. *Terminalia* is well represented in tropical Australia, while *Lumnitzera* has two species of mangroves, both of which are found in Australia, and *Macropteranthes* is an Australian genus of evergreen shrubs or small trees with four species, each of restricted occurrence in Queensland or the Northern Territory. Leaves of the Australian species are spirally arranged, often crowded at the ends of branchlets, simple, entire, often with glands on petioles, leaf bases or laminae and, in *Terminalia*, deciduous. In some species of *Terminalia*, sympodial branching leads to a tiered arrangement of the crown. Flowers are bisexual, or male flowers are produced on the upper parts of spikes only; the perianth is united at the base forming a calyx tube, which extends above the ovary as a shallow cup with five triangular lobes. Petals are absent (*Terminalia*) or fall early; there are 10 stamens in most species. The fruits of *Terminalia* are dry, two-winged nuts or succulent, usually globular drupes; those of *Lumnitzera* and

Macropteranthes are corky or woody, elongated or conic, with persistent calyx lobes and bracteoles.

The family Cunoniaceae is strongly represented in Australia, five of the 13 genera being endemic. They have opposite, simple, trifoliolate or pinnate toothed leaves, often with conspicuous stipules. Flowers have four or five sepals usually the same number of petals, but no petals in *Geissois*, *Pseudoweinmannia* or *Ceratopetalum apetalum* and twice as many stamens. The fruits are two to four-valved capsules except in *Ceratopetalum* and *Schizomeria*. Apart from *Ceratopetalum*, with eight species, the Australian genera are represented by one or two species, mostly occurring in rainforests or on stream banks.

Elaeocarpaceae is strongly represented in South-East Asia and South America; in Australia *Elaeocarpus* has about 20 species, occurring mainly in the rainforests of Queensland but extending from the Northern Territory to Tasmania. They have alternate, toothed leaves and bear their flowers in showy racemes; the flowers have five sepals and five fringed petals (except *E. holopetalus*), numerous stamens usually covered by short hairs and a two to five-celled ovary. The fruit is blue or black, with a fleshy outer layer covering a hard stone. *Sloanea* fruits are hard and dry, covered with rigid bristles and opening in two-four valves to expose the seeds, which are covered by a scarlet pulp or reddish coating. *Sloanea* flowers have numerous stamens, as in *Elaeocarpus*, but petals are undivided, or absent. The *Sloanea* species and some species of *Elaeocarpus* have prominent buttresses, which may extend up the trunk to a considerable height.

The family Eucryphiaceae, with a single genus *Eucryphia*, was earlier included in Saxifragaceae by some botanists and in Rosaceae by others. There are four species in Australia and three in South America. Of the two Australian tree species, the Tasmanian *E. lucida* has simple leaves while *E. moorei* of New South Wales has pinnate leaves, the leaflets of which are oblong and paler on the undersurface, like the leaves of *E. lucida*, but which have a fine extension at the tip. The young leaves, stipules and buds of *Eucryphia* are covered by a resinous substance; stipules of the pairs of opposite leaves are joined between the petioles. The four sepals of the flower are shed as a unit as the flower opens. Eucryphiaceae is evidently a family of the Gondwana flora, now restricted to cool moist climates.

The family Euphorbiaceae consists mainly of herbs but there are several genera with tree species in Australia, including the mangrove *Excoecaria agallocha*. Trees in this family have mostly alternate leaves, which are simple, usually entire and frequently have two small glands at the top of the leafstalk. Some species have milky or coloured sap or clear sap which becomes coloured on exposure to the air; it is usually poisonous. Flowers are unisexual, often lack petals and commonly have a three-celled ovary which develops into a three-lobed capsule, although, amongst the Australian species, *Drypetes deplanchei* has red single-seeded fleshy fruit and *Bridelia exaltata* has yellow two-seeded



Cunoniaceae
(*Geissois benthamiana*)



Elaeocarpaceae
(*Sloanea woollsii*)



Eucryphiaceae
(*Eucryphia lucida*)



Fagaceae
(*Nothofagus cunninghamii*)



Lauraceae
(*Cryptocarya erythroxylon*)



Meliaceae
(*Dysoxylum fraserianum*)



Meliaceae (*Toona ciliata*)

fruit, while *Austrobuxus swainii* has two-celled capsules, each cell containing a single yellow-plumed seed, and *Glochidion ferdinandii* has five to seven-celled capsules with one to two seeds per cell.

Nothofagus is the only genus of the family Fagaceae occurring naturally in the southern hemisphere. It is well represented in South America, New Zealand, New Guinea and New Caledonia, and fossil (pollen) evidence shows that it was widespread in Australia in the early Tertiary period. At present there are three Australian species occurring in cool moist regions of Tasmania, eastern and southern Victoria, northern New South Wales and south-eastern Queensland. *Nothofagus gunnii* is the only known cold-deciduous tree in Australia.

Lauraceae is a family that is widespread in tropical and subtropical regions of the world, but in Australia the native trees in this family are restricted to the rainforests and gully vegetation, where they may be a conspicuous element. Species of *Beilschmiedia*, *Cryptocarya*, *Endiandra* and *Litsea*, with alternate, simple, entire leaves, often having very small oil glands, are very similar in appearance. *Cinnamomum* species usually have opposite leaves, while those of *Neolitsea* are clustered. In *Litsea* and *Neolitsea* the flowers are borne in clusters, surrounded by deciduous bracts, and the fruit is held in a cup-shaped receptacle. In *Cryptocarya* the perianth tube encloses the fruit, so that the lobes of the perianth are carried at the top of the fruit, while both *Endiandra* and *Beilschmiedia* carry the remains of the perianth at the base of the fruit. The last two genera are distinguished by *Endiandra* having three stamens and *Beilschmiedia* having nine. Many of the northern Queensland trees in this family are known as walnuts (*Beilschmiedia* and *Endiandra*) or laurels (*Cryptocarya*).

Meliaceae is a family of tropical and subtropical trees including some which produce excellent timbers. They have large simple, pinnate or bipinnate alternate leaves, without stipules; many species are deciduous. Flowers are borne in large panicles and have four to six sepals and petals, usually twice as many stamens, mostly united into a tube. The fruit is a two to five-celled capsule or berry with one to several seeds. Many of the species occur in rainforests but species of *Xylocarpus* occur as mangroves, and some *Owenia* species are found in deciduous vine thickets and semi-arid woodlands. *Toona ciliata*, the Australian red cedar, is probably the best-known species but white cedar, *Melia azedarach*, is widely planted as a hardy ornamental tree. *Dysoxylum* with 15 species, has the largest Australian representation. Of the major Australia genera, *Melia* is distinct in having bipinnate leaves with toothed leaflets, pale lilac-coloured flowers and yellow berries. *Toona*, of which the pinnate leaves have asymmetrical leaflets with drawn-out tips and blunt bases, has fragrant white flowers with four to six free stamens, and light-brown five-valved capsules containing up to 25 winged seeds. *Dysoxylum* also has pinnate leaves, variable between species. All have small, cream or mauve flowers with the anthers borne on the inner side of a staminal tube, and capsular fruits up to 5 cm in diameter and

two to five-celled, with one or two seeds in each cell. *Owenia* has pinnate leaves, often blunt-tipped, and anthers borne on a staminal tube, but the fruit is a drupe with a fleshy outer coat surrounding a hard, woody stone containing two to four single-seeded cells.

Monimiaceae appears to be an ancient family with representatives in South America, Australasia and Malagasy Republic, and fossils in Europe. Leaves are opposite, often toothed, and various parts of the tree are strongly aromatic, giving rise to the common name of sassafras. Flowers are usually unisexual, with a lobed or toothed perianth, often cup-shaped, enclosing six or many anthers or carpels, the latter developing into achenes covered with fine hairs (or smooth and succulent in *Wilkiea*). The major Australian genera are *Atherosperma*, *Daphnandra* and *Doryphora*. *Atherosperma* has acutely pointed, toothed or entire leaves, paler on the underside, and occurs in cool temperate rainforests of Tasmania and Victoria (with minor occurrences in New South Wales). *Daphnandra* also has acutely pointed, toothed leaves but these are green on the underside; there are two species in New South Wales rainforests and two in tropical Queensland. *Doryphora*, with two species, is distinguished by having long extensions to the stamens; its leaves are bluntly pointed, coarsely toothed and green on the undersurface. *Doryphora sassafras* occurs in temperate rainforests from the Macpherson Range to southern New South Wales, while *D. aromatica* occurs in the rainforests of northern Queensland.

Moraceae, with simple, entire or toothed leaves, milky sap and unisexual flowers in compound inflorescences, is a family which is widely distributed in the tropics and subtropics. The most conspicuous genus is *Ficus*, which has fruits aggregated inside a fleshy receptacle. Each leaf is enclosed during development in a single, broad-based stipule which falls to leave a ring-like scar. Figs are common in Australian tropical and subtropical rainforests, but occur also on rocky sites in monsoon and arid zones. *Streblus*, also widespread but less common than *Ficus*, has elliptical leaves with drawn-out points, toothed margins and rough surfaces. Its fruits are small, ovoid and fleshy, with a single seed.

The most conspicuous and characteristic group of Australian trees is the family Myrtaceae, and particularly the subfamily Leptospermoideae which includes dry-fruited forms such as *Eucalyptus*, *Angophora*, *Syncarpia*, *Lophostemon* and *Melaleuca*. These have simple, entire leaves, usually with oil glands but without stipules, and bisexual flowers with the ovary at least partly enclosed in a hypanthium so that the four or five sepals, four or five petals (where present) and numerous stamens are borne above or in a ring surrounding the ovary, which has several cells and numerous ovules.

The eucalypts, the largest genus in the family, occur over a wide range of climates and sites in Australia (plus a few in islands to the north), but not in mangroves, rarely in rainforests and only sparsely in arid areas. Eucalypts are distinguished within the family by the possession of opercula (single or double) covering the floral buds, and the



Monimiaceae
(*Doryphora sassafras*)



Monimiaceae
(*Atherosperma moschatum*)



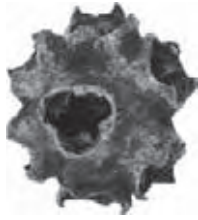
Moraceae (*Ficus macrophylla*)



Myrtaceae, subfamily
Leptospermoideae
(*Eucalyptus pellita*)



Myrtaceae, subfamily
Leptospermoideae
(*Melaleuca quinquenervia*)



Myrtaceae, subfamily
Leptospermoideae
(*Angophora glomulifera*)



Myrtaceae, subfamily
Leptospermoideae
(*Angophora floribunda*)



Myrtaceae, subfamily
Myrtoideae
(*Syzygium suborbiculare*)

lack of petals. The genus is treated more comprehensively later (see p. 200).

Angophora and *Syncarpia* have opposite leaves—often clustered at the end of each growth flush in *Syncarpia*—but while *Angophora* has separate, stalked fruits, usually ribbed and bearing small calyx teeth on the rim, in *Syncarpia* the fruits are united to form a woody mass with seven openings. *Melaleuca* and *Lophostemon* have their stamens united into five bundles; in *Melaleuca* the flowers are stalkless and arranged in heads or spikes, while in *Lophostemon* each flower is stalked. *Angophora* species occur in dry sclerophyll forests or woodlands, over a range of sites; *Lophostemon* and *Syncarpia* are typical of wetter sites, stream banks or rainforest margins, but *Melaleuca* species occur over a wide variety of conditions, from freshwater swamps and seasonal floodplains to deep sandplains, which have strongly impeded drainage.

The fleshy-fruited Myrtaceae (subfamily Myrtoideae) include many trees of tropical to temperate rainforests—one species, *Syzygium smithii*, extends to Wilsons Promontory in Victoria—the capsular fruited *Backhousia* and *Lophostemon* forming links between these and the genera of the drier forests and woodlands, e.g. *Eucalyptus*. Leaves in this subfamily are simple, opposite, entire, usually tapering to a slender point and usually with translucent oil glands. Flowers are coloured in a few species but generally white or cream, with four or five petals, numerous free stamens and the ovary immersed in the hypanthium. Fruits vary in diameter from 0.5 to 7 cm, in colour from white through yellow or red to blue, purple or black, and contain one (*Acmena* and *Syzygium*) to many (*Rhodomyrtus*) seeds. The subfamily includes both small and large trees with bark types ranging from smooth, mottled brown and green, through papery-scaly to fibrous.

In Pittosporaceae seven of the 10 genera are endemic to Australia. *Hymenosporum* occurs as well in New Guinea, and *Citriobatus* in Java and the Philippines, but *Pittosporum* has a wide distribution, from the Atlantic island of Madeira through Africa and Asia to the Pacific as far as New Zealand and Hawaii. The Australian species of *Hymenosporum* and *Pittosporum* are small to medium-sized trees of tropical and temperate rainforests or stream banks. One species (*P. phillyreoides*) occurs widely in arid low open woodlands. Trees in Pittosporaceae have alternate, simple, entire leaves, sometimes clustered at the ends of the twigs, rather large, fragrant white or yellow flowers with five sepals, petals and stamens. The fruits are two- or three-valved capsules containing winged (*Hymenosporum*) or sometimes sticky (*Pittosporum*) seeds.

Another characteristically Australian tree family is Proteaceae. This family, and particularly subfamily Grevilleoideae, is strongly represented in north-eastern Australia by numerous endemic genera. The most widespread genera, *Banksia* and *Grevillea*, include many shrubs as well as trees, but several genera have one or a few species and occur only in rainforests. The Proteaceae are characterised by usually bisexual flowers with a four-lobed petaloid perianth (tepals), four stamens

which are often attached to the tepals and a one- or two-celled ovary, often borne on a stalk (gynophore). Proteaceous leaves are usually alternate and without stipules, simple (occasionally compound) and entire or variously lobed and divided, and sometimes with apparently primitive or reduced venation. Many of the tropical species have large, deeply divided juvenile leaves.

The most distinctive genus in Proteaceae is *Banksia*, which is characterised by producing its flowers in dense cylindrical or globular spikes with very numerous projecting styles. The fruits become embedded in the swollen axis of the spike, to form a woody cone-like mass with horizontal lip-like valves. *Banksia* is widespread in eastern and southern but particularly south-western Australia.

Grevillea is also widespread but few species reach tree size; two well-known species are *Grevillea robusta* (silky oak) and *G. striata* (beefwood). Many of the *Grevillea* species have showy bright-coloured flowers in large racemes and leathery fruits, one- or two-seeded. Leaves may be entire or variously dissected.

The pan-tropical family Rhizophoraceae consists of about 20 genera of mangroves and rainforest trees, centred in South-East Asia, with four genera represented in Australia. The Rhizophoraceae have opposite leaves with conspicuous stipules which sheathe the growing point somewhat like the stipules of figs. In many species there are small red-dish-brown spots formed by groups of corky cells on the undersurface of the leaves. Inflorescences are axillary, normally in cymes or reduced cymes. In the flower, the calyx has 3–16 persistent lobes, the same number of petals (which fall early and are commonly lobed or fringed) and two or three times as many stamens. Fruits are fleshy, with the persistent calyx lobes either at the top or, by differential growth of the fruit, towards the base and reflexed. In the mangrove genera the seeds germinate on the parent tree.

Rhizophora is probably the most easily recognised mangrove genus, with looping pneumatophores developed from the prop roots, and aerial roots from the branches. *Bruguiera* has stilt roots from the base of the trunk, and knobby pneumatophores, while *Ceriops*, normally only a shrub, has small prop roots and a club-like stem. *Carallia brachiatata*, the only Australian non-mangrove representative of this family, occurs in the vine forests of the tropics, but occasionally forms aerial roots from the lower part of the trunk.

Rosaceae is a very large and diverse family, mostly occurring in temperate regions and with many species in cultivation. There are herbs, shrubs and trees in the family; leaves are usually alternate, with stipules, often pinnate and toothed, and often deciduous. The flowers are basically bisexual and regular, with four or five calyx lobes, the same number of petals and many stamens in whorls of five, borne on the edge of a hypanthium. There is a progression from a single pistil, producing a fleshy fruit such as the cherry, through multiple separate pistils producing aggregate fruits, like blackberry, or enclosed in the



Proteaceae
(*Banksia integrifolia*)



Proteaceae (*Grevillea robusta*)



Rhizophoraceae
(*Rhizophora stylosa*)



Rubiaceae (*Nauclea orientalis*)



Rutaceae
(*Flindersia brayleyana*)



Santalaceae
(*Santalum spicatum*)



Sapindaceae
(*Diploglottis australis*)

hypanthium, as in the rose, to usually five carpels fused with the hypanthium as in pome fruit. Australia has very few native members of this family and these are mostly herbs or scrambling shrubs.

Rubiaceae is a very large family of mostly tropical plants, but representation in Australia is not great. The major Australian tree species is *Nauclea orientalis* which occurs mainly on river levees across the northern part of the continent. The Rubiaceae have opposite or whorled leaves, often with stipules joining the petioles of each pair of leaves and leaving a scar on the stem when they fall. In *Nauclea* the stipules are large and circular; the uppermost pair of stipules encloses the growing point.

Rutaceae also has oil glands in the leaves, which are usually opposite and may be simple, trifoliolate or pinnate and occasionally toothed. Flowers have four or five sepals and petals, and as many or twice as many stamens as petals. The ovary consists of four or five (occasionally up to nine) carpels which may be more or less separate. Fruit varies from fleshy and citrus-like to one to five-celled capsules. In *Flindersia* the five carpels are united in a capsule which splits into boat-shaped segments. *Flindersia* is one of the most important sources of Australian cabinet timbers, including Queensland maple, silkwood and silver ash, although several species in Rutaceae have hard, tough wood; however, they are generally available in only small quantities. Most trees in Rutaceae occur in rainforests, but some species of *Geijera* and *Flindersia* are found in deciduous vine thickets and semi-arid woodlands.

The family Santalaceae consists of shrubs and trees which are usually parasitic on the roots of other plants, but they do have some chlorophyll-bearing tissues and might therefore be considered as hemi-parasites. They are distinguished from Loranthaceae by the fact that the ovules are differentiated from the placenta, although without integuments. (The Western Australian Christmas tree, *Nuytsia floribunda*, belongs in Loranthaceae.) The two main tree genera of Santalaceae in Australia are *Exocarpos* and *Santalum*. The native sandalwood, *Santalum spicatum* is a shrub of semi-arid regions, the wood of which is used as incense. *Santalum* has lanceolate or linear leaves; *Exocarpos* has scale-like leaves on green twigs; the fruits are small nuts borne above swollen and succulent, often coloured, pedicels. *Exocarpos* species are common in open forests, as understorey trees with dense dark green crowns; they commonly produce root-shoots when the ground is disturbed.

Although the family Sapindaceae is widespread in the tropics and subtropics and well represented in Australia many of the species are small trees, occurring mostly in dry or littoral rainforests from northern Queensland to southern New South Wales, with one species, *Alectryon subcinereus*, reaching East Gippsland. Several tree species occur in the monsoon forests of the Northern Territory; *Atalaya hemiglauc* is widespread in woodlands of the semi-arid zone, from northern New South Wales to the Hamersley Range in Western

Australia. The leaves of sapindaceous trees are alternate and compound, consisting of 2–12 leaflets (up to 18 in *Jagera pseudorhus*) often irregularly arranged and without a terminal leaflet. Flowers are usually small and numerous, in panicles or racemes, and fruits are commonly two- or three-lobed capsules, winged in *Atalaya*, splitting to reveal one or two (in *Harpullia*) dark seeds, commonly with a red or yellow aril. The wood is very hard and the surface of the sapwood is corrugated.

Sterculiaceae includes large, prominently buttressed trees of the rainforests (*Argyrodendron*) and non-buttressed but often swollen-stemmed *Brachychiton* species, some of which grow in rainforests while others occur in much drier formations ranging from sclerophyll forests to shrublands of the arid zone. One species of *Heritiera* is a tropical mangrove. In this family the leaves are alternate and may be simple, often deeply lobed (*Brachychiton*) or digitately compound (*Argyrodendron*). Species of *Brachychiton*, including those of the rainforests, are briefly deciduous and flower usually in the leafless state. In the major tree genera the flowers are often unisexual, lack petals and have their stamens united into a cup, tube or globular mass, while the three to five, more or less separate carpels of the ovary develop into separate, one-seeded, winged fruits or several-seeded boat-shaped follicles.

The family Verbenaceae includes many genera of trees, shrubs, herbs and lianes, mostly in the tropics and subtropics. Rainforest trees in the genera *Gmelina*, *Vitex* and *Premna*. This family includes some excellent timber trees, the best known being teak, native to South-East Asia, and, in Australia, white beech, *Gmelina leichhardtii*. In Verbenaceae the leaves are opposite, usually simple and entire, and sometimes deciduous. The inflorescence is compound, often large and showy, with blue, yellow or purple flowers. Fruits are usually fleshy, with a hard inner part divided into four one-seeded cells, and blue or pink in *Gmelina*, red or black in *Vitex* and *Premna*. *Gmelina* has large ovate leaves with conspicuous venation, and fine brown hairs on the undersurface; *Premna* has smaller lanceolate leaves, glossy on the upper surface; *Vitex* usually has digitate leaves with three to five narrow leaflets.



Sterculiaceae
(*Brachychiton populneus*)



Sterculiaceae
(*Argyrodendron actunophyllum*)



Verbenaceae
(*Gmelina leichhardtii*)

Factors Controlling the Distribution of Australian Tree Species

The present distribution of tree species in Australia is the result of the interaction of several factors on successive generations of individual trees, going back at least to late Tertiary times.

Past climates and the changing Australian landscape

Fossil pollen data indicate a continued dominance of rainforest in the east and south-east during the Miocene, although elements of open forest are present—*Acacia*, *Casuarina*, Myrtaceae, Proteaceae, Compositae and Gramineae. In central Australia there is evidence of more open grassland but some rainforest persisted, apparently along the watercourses, and there were increasingly arid conditions in the north-west of the continent.

During the Miocene considerable areas of southern Australia were submerged, destroying the existing vegetation, imposing barriers to east-west migration and, particularly in the Great Australian Bight region, resulting in the formation of extensive limestone deposits which later formed calcareous soils, thus perpetuating the barriers to migration.

In the late Miocene, earth movements in eastern Australia initiated the uplift of the Great Dividing Range and rejuvenated the erosion cycle. Somewhat later, probably during the Pliocene, block-faulting in South Australia elevated the Mt Lofty–Flinders Range system and produced the St Vincent and Spencer Gulfs, simultaneously increasing the range of sites available and imposing additional barriers to migration. The Pliocene also appears to have been a period of generally wet climate with formation of extensive laterites, possibly drier than the Miocene but without strong seasonal contrasts.

Information about the Pliocene flora is limited but there are indications that Myrtaceae and *Casuarina* were common in inland New South Wales. *Nothofagus* pollen disappeared from this area in the early Pliocene, but reappeared briefly in the middle Pliocene, without representation of *N. brassii* type, which is now found in *Nothofagus* species in New Guinea.

During the early Pleistocene an east-west fold in the central part of South Australia, associated with down-warpage on its northern side, cut off the flow of the central Australian rivers and formed an extensive lake, including the present Lake Eyre and possibly Lakes Blanche, Gregory, Callabonna and Frome. Large lakes were also formed in the Murray basin near the present border between Victoria and South Australia and in the Fortescue basin in Western Australia.

The Pleistocene saw a series of glacial and interglacial periods, which were arid and humid respectively, so that during the glacial periods the more mesic flora would be forced by temperatures to migrate northwards and by water availability to move towards the wetter eastern and southern coastal regions. Evidence from buried soils is that there were four arid periods. During the interglacials the climate of much of northern Australia may have been suitable for rainforest; it is possible that species such as the palms *Livistona mariae* in central Australia and *L. alfredii* in the Fortescue River area of Western Australia became established in this period although they may well have entered the areas much earlier, during the late Miocene or Pliocene, and persisted through the arid periods.

The alternating cold-dry and warm-moist periods would have resulted in movement of climatic zones and the loss or fragmentation of plant populations. This would have been followed by replacement, either by expansion of remnants of the earlier flora or by invasion of new species, and the Pleistocene must have been an important period in the evolution and distribution of Australia's flora. This is particularly true of the most recent glacial period, which commenced about 40 000 years ago, reached its maximum between 20 000 and 17 000 years ago, and ended about 10 000 years ago. During this period, glacial and periglacial conditions in Tasmania and the highlands of the south-eastern part of the mainland, lowered the tree line. Increased aridity in central Australia caused loss of vegetation, extensive wind erosion and formation or extension of sand dunes, and lower sea levels extended the shorelines so that the mainland was joined to Tasmania and New Guinea.

Between 8000 and 3000 years ago the climate became warmer and wetter than at present, allowing re-vegetation of inland sand dunes and replacement of eucalypt forest with rainforest in parts of north-eastern Queensland, and alpine herbfields with woodland at high altitudes.

From 3000 years to the present there appear to have been minor fluctuations but generally slightly drier conditions, affecting the size of lakes, the boundaries of vegetation and the proportional composition of flora rather than producing sweeping changes in the vegetation.

The effects of Pleistocene fluctuations in climate are seen in the occurrence of closely related species in eastern and western regions and the disjunct distribution of species, either across south-eastern Australia (e.g. *Eucalyptus macrorhyncha*) or along the eastern mountain chain (e.g. *Nothofagus moorei*).

As a result of these historic influences, a suite of species is potentially available for each site. Actual occurrence depends on the effects of climate, topography, soil, fire, insect or other animal predation, disease and competition.

These factors have been considered for each of the species treated in this book, although not all are specifically mentioned for each species.

Present climates

Because of Australia's geographic position, the mainland lying between 10° and 39°S latitude, with Tasmania extending almost to 44°S, and generally low altitude, it is a warm to hot, dry country (Figs. 4, 5). In summer, daily maximum temperatures of over 30°C are common, and periods of several days when the maximum is over 38°C occur each summer over much of the inland region. There is little indication that these high temperatures directly control the distribution of native plants, however, because there is always an association with water balance.

Figure 4. Average daily minimum temperature for July (isotherms in °C).





Figure 5. Average daily maximum temperature for January (isotherms in C°).

Low temperatures, on the other hand, do appear to control the distribution of many species. The height of the tree line is about 2000 m in the Kosciusko area and 1300 m in Tasmania; at these altitudes the temperature range of the hottest month is about 5 to 14°C and for the coldest month about -5 to +2°C. Both of these parameters may be significant: the summer temperatures indicating the potential for sufficient net photosynthesis to allow growth of woody tissues; the winter temperatures showing the possibility of frost injury. Frost injury may also inhibit tree growth in highland valleys, where temperature inversions may lead to winter temperatures as cold as those at the upper tree line (Fig. 6).

Solar radiation is important both directly for the promotion of photosynthesis and indirectly for its effect on soil and plant temperatures. On a broad scale, radiation (expressed here in units of $\text{cal cm}^{-2} \text{ day}^{-1}$) is more or less constant at about 450 across the northern part of Australia; in January there is an increase to about 650 over the central part of the continent, then a decrease to about 500 in Tasmania (Figs. 7, 8). In July there is a fairly uniform gradient from 450 in the north to 150 in Tasmania. This broad pattern is modified by the presence of cloud and atmospheric moisture so that, in general, coastal localities have lower radiation values. Topographic shading is also important in the mountainous areas.

Annual rainfall is a first approximation of the supply of water for plants but the effectiveness of rainfall is modified by seasonal distribution, intensity, soil storage, evaporation, run-off and run-on. Mists and fogs may further add to water supply. Demands for water or potential water losses must also be taken into account. These are due to direct evaporation and transpiration, both of which are related to solar radiation, air temperature and wind. The distribution of species is a function of, on the one hand, the relative ability to grow rapidly when water is not limiting and, on the other, the ability to survive periods of drought stress.

Australia is often cited as the driest continent; 37 per cent of its area receives less than 250 mm of rain annually, 57 per cent gets less than 375 mm and 68 per cent gets less than 500 mm. The mean

Figure 6. Frost period—
median annual length (days
per year). A frost day has a
minimum temperature
 $\leq 2^{\circ}\text{C}$.



annual rainfall shows a broad pattern of concentric zones, from less than 125 mm in the northern part of South Australia to over 4000 mm in north-eastern Queensland and about 3700 mm in western Tasmania (Fig. 9). Small areas in the southern part of Western Australia, on the highlands of Victoria and near Darwin receive over 1500 mm.

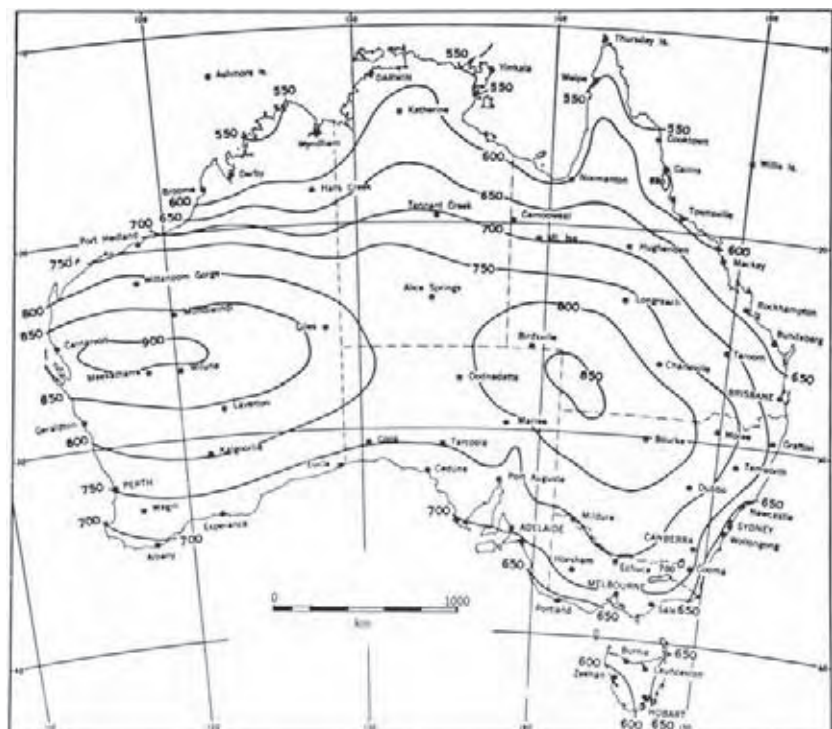


Figure 7. Global radiation
for January (average daily
amount in milliwatt-hours
per square centimetre;
based on Eppley
pyranometer data
1968–74).



Figure 8. Global radiation for July (average daily amount in milliwatt-hours per square centimetre; based on Eppley pyranometer data 1968–74).

The season of maximum rainfall and the total amount vary around the continent (Figs. 10, 11). The land north of the Tropic of Capricorn receives at least 50 per cent of its annual rain in summer (up to 70 per cent around the Gulf of Carpentaria) under the influence of the monsoon and cyclones, plus an input from orographic uplift of the tradewinds on the eastern coastal range. The western coast south of the Tropic receives at least 50 per cent of its rain in winter, associated with the passage of

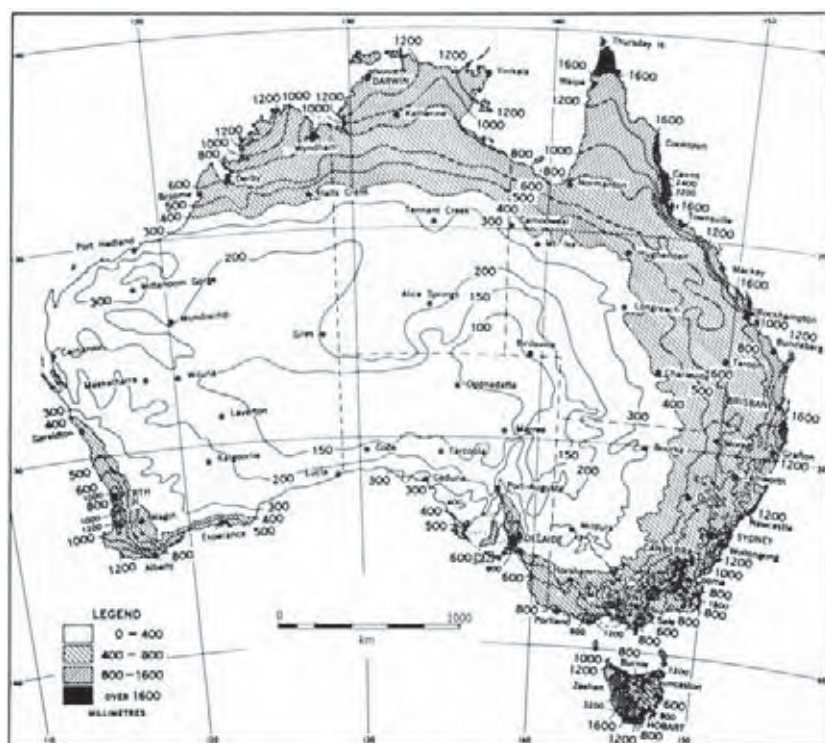
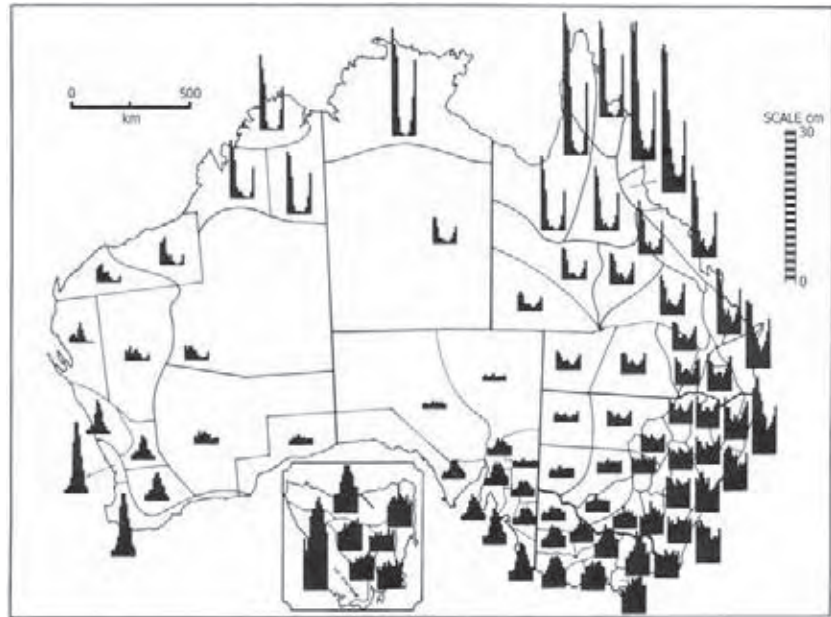


Figure 9. Mean annual rainfall (isohyets in millimetres).

Figure 10. Average rainfall for each month of the year in the various Australian rainfall districts, the boundaries of which are indicated on the map. In the individual block histograms, the columns are for the successive months January to December from left to right; the height of each column represents the average monthly rainfall according to the scale given.



fronts between successive anticyclones. The south-west receives less than 10 per cent of its rain in summer, while the north receives less than 10 per cent of its rain in winter, with a marked deficiency in spring as well. Only in the south-eastern region is rainfall distributed more or less evenly, with at least 20 per cent in each quarter, but even here there is a tendency for a spring drought on the New South Wales coast and a summer drought in western Victoria.

The pattern of evaporation in Australia shows concentric zones around a maximum value of over 3300 mm per annum in the northern part of South Australia (Figs. 12, 13). The western and northern regions have relatively higher evaporation rates so that, for example, Carnarvon has an evaporation of

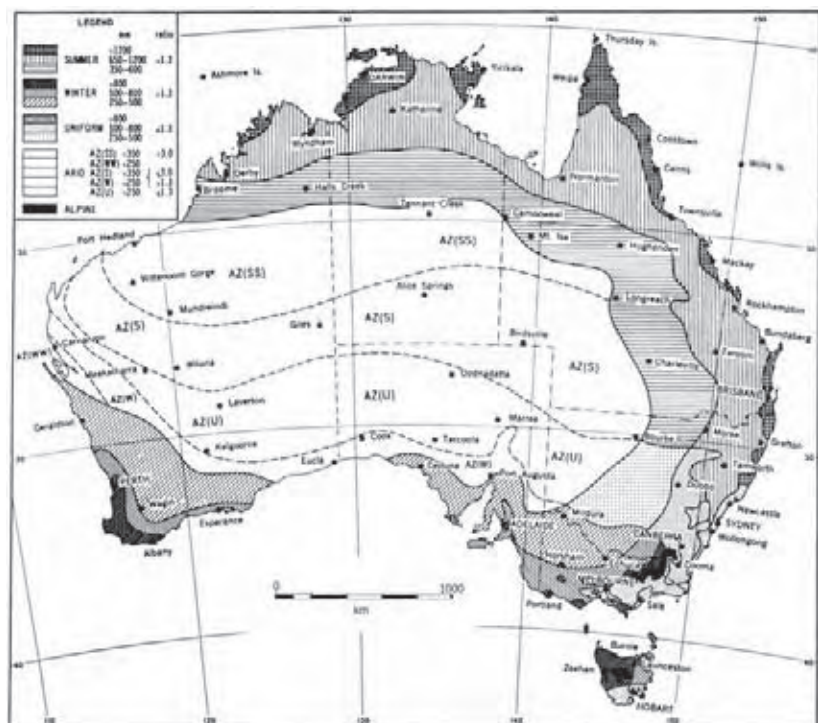


Figure 11. Seasonal rainfall zones for Australia. The classification is based on annual rainfall, seasonal incidence and altitude. The seasonal incidence is determined from the ratio (greater/less) of the median rainfalls over the periods November–April (summer) and May–October (winter).

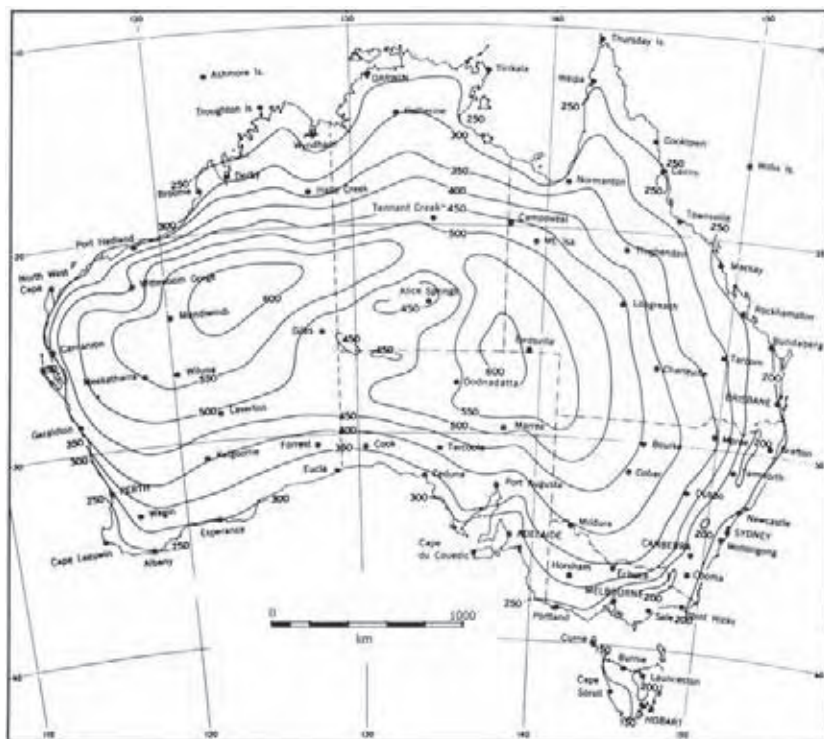


Figure 12. Mean evaporation (in millimetres) during January.

about 2550 mm while Bundaberg at around the same latitude has a value of about 1250 mm. The gradients are less steep to the north than to the south, so that the value for Darwin is about 2200 mm and for Daly Waters 2300 mm while, over a similar distance in Victoria, Melbourne at 1000 mm is much lower than Merbein at 1500 mm. Seasonal distribution is strongly affected by latitude. Normanton (17°39'S) has a range from 145 mm in July to 256 mm in November and an annual mean of 2250 mm;

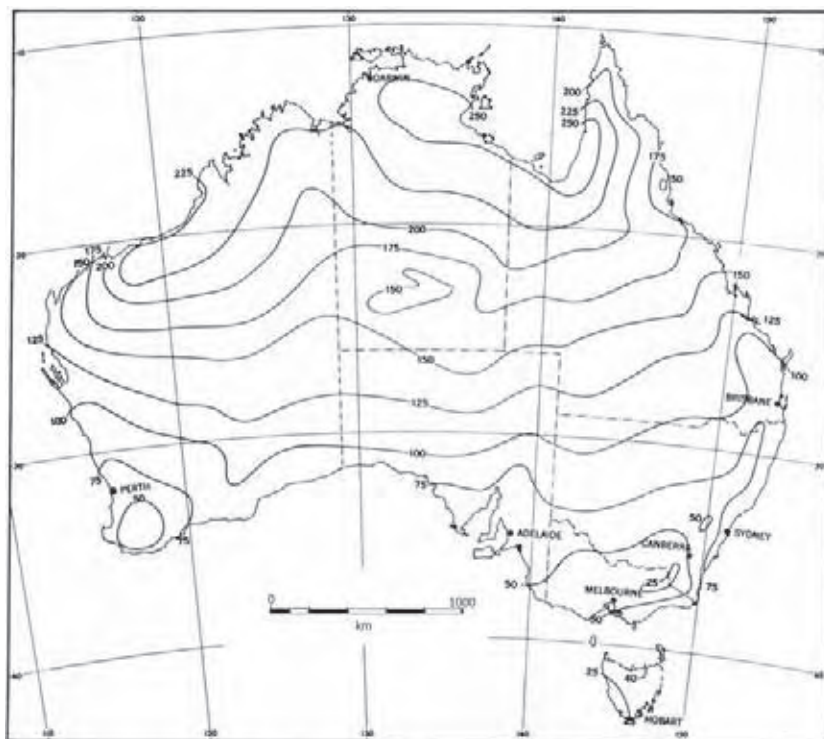


Figure 13. Mean evaporation (in millimetres) during July.

for Broken Hill (31°57'S) equivalent values are 73 mm in July, 325 mm in January and an annual mean of 2260 mm.

Altitude also affects evaporation rates. Alice Springs at 579 m has a mean annual evaporation rate of about 2400 mm while Oodnadatta, at 117 m, has a rate of about 3400 mm. On the central plateau of Tasmania, where the effects of latitude, altitude and nearness to the sea reinforce one another, evaporation is below 500 mm.

Wind is also an important climatic factor, although its effects are mainly seen in the structure of vegetation and the shape of trees, rather than the distribution of species. Moderate winds may ameliorate the climate, persistent strong winds may inhibit flowering or fruiting, and cyclones cause considerable damage by defoliating, breaking or uprooting trees, but most wind effects are indirect, such as leaf scorch by salt spray in exposed coastal situations, sand blasting or burial of seedlings, and the increase in intensity and rate of spread of fire.

In the north the most significant winds are the south-easterly tradewinds, which bring increased rain to the Queensland coast but lead to a build-up of heat in the Kimberley and Pilbara regions of the north-west. The southern part of the continent is affected strongly in summer by hot dry winds from the interior, associated with the passage of anticyclones and alternating with polar maritime air bringing southerly or south-westerly 'cool changes'. The winter rainfall of southern Australia is associated with south-westerly winds of the cold fronts in mid-latitude depressions. Tasmania is affected by these mid-latitude depressions for a much greater part of the year, resulting in an almost continually wet climate on the western part of the island.

The El Niño Southern Oscillation (ENSO) causes variation in climate across large parts of Australia. El Niño is a natural part of the climate that has been affecting Australia for thousands of years. It refers to sustained, large-scale warming of water in the Pacific Ocean that causes changes in the atmospheric circulation of moisture across the Pacific Basin. El Niño events in Australia are often linked to drought conditions as they typically cause reduced rainfall across many parts of eastern and northern Australia. They occur every 4–7 years and last around 12–18 months.

Topography

Topography—the shape of the land surface and the relative position of its features—affects the distribution of plant species largely through the modification of climate and indirectly through its effects on soil properties.

Flat, level plains usually result in a monotonous environment and relatively uniform vegetation with widespread species. Irregularities of the surface initially affect the surface movement of water, with increased availability to plants in the hollows and drier conditions on the rises. With the formation of watercourses the contrast between wet and dry sites is accentuated so that a new suite of species, often markedly different from those of the surrounding country, is established.

In hilly country, differences in slope and aspect cause differences in climate, associated primarily with the amount of solar radiation falling on the surface. This results in lower temperatures and reduced evaporation from shaded slopes.

Lower temperatures also occur as a result of the down-slope movement and pooling of cold air in hollows, particularly at higher altitudes, where 'frost hollows' are typically treeless and fringed by cold-tolerant species.

Topography also has a significant effect on direction, funnelling and turbulence of the wind in exposed situations, causing increased damage, while the reduced wind-speeds in sheltered sites may enable species to survive in otherwise inhospitable localities. On a rather larger scale, the presence of mountain ranges such as those parallel to the eastern coast of Australia causes uplift of the onshore winds with consequent cooling and condensation to form cloud (reducing radiation) and rain on the

windward slopes and crests. At the same time, rain shadows often occur in the lee of such mountains.

Soils

Within any climatic region the distribution of the tree flora is controlled largely by soil properties, which in turn are strongly influenced by topography and parent material, but also by past and present climate.

Much of the land surface of Australia was subjected to levelling by erosion and intense weathering during the Tertiary era (60–20 million years ago). This produced large areas of strongly leached soils (laterites) some of which are still more or less intact today. Where the Tertiary soils were eroded, newer soils developed on the remnants or on the redeposited erosion products and these, too, are extremely low in nutrients. Many Australian soils show a strong contrast between the topsoil and lower horizons. This is often due to normal soil-forming processes, but an increasing number of soils are being recognised as the product of successive cycles of erosion and deposition, giving layers of different ages and textures. Where the underlying layers are of heavy clay they present problems for water movement and for penetration by roots: they may be waterlogged to the surface during wet weather but excessively dry at other times.

The concurrent processes of weathering and erosion produce new supplies of mineral nutrients where igneous rocks occur, but very little is produced from the already highly-leached materials of the Tertiary surfaces or from the older sedimentary and metamorphic rocks. Alluvial soils may have high or low nutrient levels depending both on the source of material and on the conditions of deposition. Fertility is usually correlated with texture, the sandy soils being generally low in fertility while the loams and clay loams are much higher.

The generally low availability of plant nutrients, and particularly of phosphorus and nitrogen, appears to have induced a general tolerance for infertile soils by most Australian plants. This tolerance is based partly on the ability to take up and use any nutrients which become available, for example, following wildfires, and partly on the accumulation and recycling of nutrients within the organic matter, so that a dense forest may develop on a soil which has extremely low levels of nutrient below the organic layers on the surface.

In contrast to the generally low availability of nutrients, there is a wide variation in the availability of water, which is strongly affected by physical properties of the soils, such as texture, structure and depth to impermeable layers. Thus, moderately deep sandy or earthy soils with higher infiltration rates and good storage of readily available water usually support better tree growth than those soils with a heavy clay layer at or near the surface.

An additional factor is that many of the heavier soils have swelling clays which crack strongly on drying, forming a surface of hard crumbs or clods, deep fissures, and gilgais. Many tree species are unable to grow on these soils.

The Tertiary laterites are still very widespread, extensive areas of deep profiles occurring, for example, in Western Australia, Arnhem Land and Cape York Peninsula, where the upper horizons are being mined locally for bauxite. These laterites are very low in nutrients but have good water permeability and storage and carry dry sclerophyll forests or woodlands. Where erosion has exposed the lower leached clays they often support only heathlands or low woodland.

Associated with laterites in northern Australia and with old erosional surfaces in many inland areas are red earths or kandosols (Isbell 1996). Some of these perhaps represent the results of erosion, redistribution and later weathering of old lateritic material under a warm moist climate.

Other kandosols have developed on materials with a fairly high silica content—granites, sandstones or metamorphic rocks—in a wide range of climate and topography. They are usually deep

sandy loams with good drainage, often with iron or manganese nodules, and a slightly heavier subsoil. Although they have high permeability they usually have moderate water-holding capacity and low nutrient levels. In areas of present low rainfall kandosols often carry acacia woodland or saltbush shrubland, but in zones of successively higher rainfall they have woodland of various eucalypts, open forest, tall open forest and even, occasionally, rainforest.

Intense physical and chemical weathering of medium-textured parent materials, under the influence of high sodium and magnesium in sub-humid to semi-arid lands, has produced extensive areas of sodosols (solonetz, solodized solonetz and solodic soils), particularly in southern and eastern inland regions. These soils often have a bleached sandy or loamy topsoil, abruptly changing to a heavy clay subsoil with impeded drainage. Many still contain large amounts of salts but are low in phosphorus and nitrogen. They usually carry woodland or dry sclerophyll forest, but where the topsoil is shallow may have only grass or shrubs. In slightly drier regions some sodosols (red-brown earths) have developed on a wide range of parent materials and may have a weaker contrast between the texture of topsoil and subsoil, and a more permeable subsoil often with calcareous concretions. They carry tall woodland of box and cypress pine in eastern Australia, and eucalypt woodland or acacia shrubland in the west.

Widely distributed in the semi-arid regions of southern Australia, calcarosols (solonised brown soils) have a sandy to loamy surface, gradually becoming heavier with depth and with alkaline subsoils usually showing calcareous concretions. These soils carry mallee in eastern Australia but have tall eucalypt woodland in Western Australia.

Podosols (podzols) and chromosols (podzolic soils) occur mainly on cool moist sites in southern and eastern Australia; podosols are generally on sandy parent material or while the chromosols typically are developed from rocks producing moderate amounts of clay. They have a bleached subsurface horizon over a layer rich in iron and sometimes with an organic hardpan. Podosols are usually low in nutrients but, because they occur in mild moist climates, are able to support eucalypt forests, often with very tall trees. They often occur on old sand dunes and may be very deep but rarely carry more than poor quality open forest or woodland. Podosols with high humus and peat content form on cool to cold wet sites usually have only heath or moor vegetation.

Ferrosols (krasnozems, euchrozems, chocolate soils) occur widely in moist to wet climates, developed mainly from basalts, but in tropical regions the parent materials include intermediate igneous and metamorphic rocks. Some ferrosols are acid red clay soils with very good crumb structure (krasnozems). They are deep, strongly weathered soils with high iron and aluminium contents which tend to fix phosphate, but because of good physical properties and moderate to high nutrient levels they normally carry rainforest (vine forest) or high quality tall open forests.

Under conditions of slightly lower rainfall and less weathering and leaching, basalts in eastern Australia produce ferrosols that are dark brown (chocolate) soils. These typically have a topsoil of friable clay loam grading into a clay subsoil. They usually carry rainforest, open forest of eucalypts or tall woodland of species such as *Eucalyptus viminalis* and *Acacia melanoxylon* and have fairly high nitrogen contents but only moderate phosphorus.

Other ferrosols have parent material with high calcium, such as calcareous shales or limestone, these include brown earths on hillsides, terra rossas on well-drained sites or rendzinas on wetter sites are formed. The brown earths are well-structured fertile soils with fairly high organic matter and they support tall open forests. Terra rossas, red or brown, rather shallow clays with moderate nutrient levels, usually carry woodland or savannah, while rendzinas usually have grasslands or savannah.

Dermosols (yellow friable clays) are subject to longer periods of high water content compared to ferrosols. They also carry rainforest or tall open forests. Dermosols include prairie soils, which may

have savannah woodland of eucalypts or semi-deciduous vine forests, and meadow soils sometimes carry tall open woodland of *Eucalyptus tereticornis* and *E. intermedia*, *Melaleuca* or *Casuarina*.

Vertosols (grey, brown and red clays) occur over a broad arc from south-eastern South Australia, through western Victoria and New South Wales and central and western Queensland to the Barkly Tableland of the Northern Territory, in a rainfall zone of 250–1000 mm. They form widely on alluvium or sedimentary rocks that weather to produce high clay contents. These soils are moderately fertile but crack deeply on drying. They commonly form gilgais. Large areas in Queensland and New South Wales carry forest of *Acacia harpophylla* (brigalow) but many other areas are treeless or have open woodlands of eucalypts such as *E. coolabah*, *E. largiflorens* or red gums.

Vertosols also form under conditions of mild weathering and low to medium leaching, on basic or intermediate rocks. These soils also commonly form gilgais; they are of relatively high fertility but normally carry grasslands and are commonly cultivated.

There are many areas in Australia where the surface materials show little or no profile development (rudosols, tenosols). These include: desert sands, which have sparse vegetation but may occasionally carry very open woodlands, notably the desert oak, *Allocasuarina decaisneana*; alluvial soils on river terraces, which often have a characteristic fringing forest of species such as *Casuarina cunninghamiana* or *Castanospermum australe*; lithosols, shallow stony or gravelly soils on hill crests or steep slopes which, in regions of moderate to high rainfall, carry well-developed open forest.

Animals

The most important animals, in terms of their effects on the natural occurrence and growth of Australian trees, are insects. Birds and mammals may be important in particular situations or for individual species, but are usually of far less consequence.

On the positive side, insects, birds and mammals such as possums and bats are necessary for pollination in many species and, depending on their foraging range, contribute to the flow of genes within and between populations. Fruit-eating birds (pigeons, cassowaries, emus) and bats may distribute seeds over relatively long distances, rats are believed to be involved in seed dispersal in rainforests, while ants, by harvesting and burying seeds, for example of acacias, act as short-distance distribution agents as well as facilitating the storage and survival of seeds which are stimulated to germination by the high soil temperatures associated with hot fires.

Animal activities are far more frequently detrimental to tree growth and survival, however. Many insects, in larval or adult form, eat leaves and in plague proportions they may defoliate or destroy the leaves of all trees over areas of thousands of hectares. The trees usually recover from single defoliations, but repeated loss of the crown can kill the tree, especially if losses are suffered in quick succession. Several orders of insects are involved in such defoliation: phasmids, beetles, wasps, moths. The whole of the leaf may be eaten, or the vascular tissues or epidermis may be avoided. Sap-sucking insects, such as lerps, coccids and leaf-hoppers, debilitate a tree and may cause death of growing tips or the shedding of leaves.

Mammals also eat the leaves and new shoots of trees; arboreal marsupials such as tree kangaroos and possums feed on large trees and seldom cause major damage to them, but they have been known to stop seedling regeneration of rainforest trees such as *Cardwellia sublimis* and *Toona ciliata*. Similarly, ground-living wallabies may inhibit the regeneration of eucalypt forest in small clearings.

The growing tips of some tree species are often attacked by moth larvae which tunnel along the shoot, killing it. Species in the family Meliaceae, such as red cedar (*Toona ciliata*) are severely affected by *Hypsipyla* species and may be prevented from producing a normal tree form, reaching the upper canopy, or flowering.

The cambial layer and sapwood are attacked by a wide range of insects, including beetles, moths and termites. Trees may be killed by girdling, by the pathogenic effects of fungi introduced often in a symbiotic relationship, or indirectly by cockatoos which weaken the stem in efforts to get to the larvae. The cambial layer on some eucalypt trees is also damaged by yellow-bellied gliders (*Petaurus australis*) biting grooves through the bark to obtain sap.

Termites attack both heartwood and sapwood of many Australian trees, but naturally-occurring trees are seldom killed; small trees of *Grevillea pteridifolia*, apparently killed by *Mastotermes darwiniensis* in northern Australia, may be exceptional. However, planted trees, particularly of exotic species, are often killed.

Insects may destroy a large part of the seed crop while it is still on the tree. Small wasps (*Megastigmus* spp.) have been shown to infest up to 80 per cent of the crop from individual trees of *Eucalyptus delegatensis*, and *Acacia aneura* has, at times, also been found to be heavily infested. Birds such as cockatoos eat large quantities of seed, particularly from large-fruited eucalypts such as *Eucalyptus miniata*, while fallen seed is harvested very efficiently by ants and smaller birds. In the rainforest, rats gnaw through the woody shells of nut-like fruits and eat the contents.

Under natural conditions, the activities of insects and other animals seem rarely to affect the overall range of species distribution. Locally, preference by leaf-eating insects for particular species has been shown to reduce growth rates and limit the competitive ability of those species against others not so heavily grazed. The drastic reduction of viable seed by insects on individual trees of species such as *Eucalyptus regnans* may result in loss of parental genotypes, if wildfires cause the death of a parent tree. This species is fire-susceptible, but normally regenerates after a fire from the seed held on the tree which is shed on to the mineral soil exposed by the fire.

On disturbed sites and especially where single-species stands of trees are established, insect populations can increase rapidly and the stand density may be severely reduced. Such population explosions and similar periodic attacks on apparently stable stands may not eliminate the tree species, but may drastically alter the composition of the stand.

Australia is fortunate in having no large browsing animals native to the country. The effects of, for example, elephants in Africa and deer in Europe have been quite serious, and feral buffalo in northern Australia have caused considerable changes in vegetation on the coastal plains, both directly by grazing and indirectly by trampling and the breaching of river levees by deep tracks which allow seawater to flood low-lying areas behind the levees. The trees most commonly killed have been *Melaleuca* species in freshwater swamps, but a wide range of trees in semi-evergreen vine forest have also been affected adversely. Rabbits in plague numbers virtually wiped out regeneration in the cypress pine forests during the first half of this century and there is evidence that, although they have been reduced to more or less stable but still large populations, rabbit browsing continues to inhibit the regeneration of trees in some areas. Several species of deer have been introduced to Australia and have become naturalized in various areas. Although they do not appear to present a major problem at present, experience in countries like New Zealand suggests that, in the absence of predators, one or more of the present colonies will eventually expand to pest proportions and threaten the native vegetation.

Microbes

Though some microbes are injurious to trees, not all are deleterious in affecting their growth. In fact there is an extensive microflora, consisting mainly of fungi but including bacteria and actinomycetes, which form associations with various trees, and which enhance the growth of the trees.

Mycorrhiza, which are associations of the fungi with roots, have been shown to occur in several genera of Australian trees including *Eucalyptus*, *Flindersia*, *Agathis*, *Araucaria*, *Callitris* and *Podocarpus*. Mycorrhizal associations are mutually beneficial in that the fungus is able to use carbohydrates from

the roots, while the fungus enhances the uptake of nutrients, particularly phosphorus, from the soil by the tree.

In *Acacia*, as in many other legumes, associated bacteria stimulate the formation of root nodules and have been shown to fix atmospheric nitrogen, which is available to the host tree and at times to the surrounding vegetation.

Casuarinas also have root nodules, which may be up to 15 cm in diameter. The microbial associates here are actinomycetes, and nitrogen fixation has been demonstrated.

Fungal diseases of Australian native trees have not been widely researched. More information is available on the same species when they are cultivated overseas. Perhaps the most catastrophic disease has been that caused by *Phytophthora cinnamomi*, known initially in Western Australia as jarrah dieback but now recognised in all States of Australia as causing the death of plants in all vegetation strata over large areas. Patterns of occurrence and plant susceptibility suggest that *P. cinnamomi* is a recent introduction to Western Australia, but was probably in the eastern region for a much longer period. This fungus appears to have the potential for drastically changing the composition of forest stands.

Several other dieback diseases occur in Australia; not all the causal agents have been identified, but root-rotting or wood-rotting fungi are associated with some. The death of single trees or groups, particularly in Tasmania and south-eastern Australia, is sometimes associated with *Armillaria* species. Other factors, such as drought stress or defoliation, appear to be involved in some cases, and the virulence differs amongst the various species of *Armillaria*.

Rust fungi (*Uromyces* and *Uromycladium* species) attack several species of *Acacia*, causing gall formation. An unidentified rust has been found to severely inhibit the growth of *Callitris glaucophylla* but not *C. intratropica* in plantations near Darwin. Many leaf spot fungi occur on eucalypts, and presumably reduce growth rates, but there is no evidence that they cause death. Fungi forming stem cankers, however, may girdle the stems and kill the distal part; such cankers are not common in Australia, although they cause problems in plantations of some species overseas. *Cytospora* species on various eucalypts are probably the most common.

Fire effects

Of the numerous factors that affect the distribution of Australian plants most notable are their adaptations to survive periodic wildfires. Major fires occur somewhere in the country almost every year, and it is estimated that about 5 per cent of Australia is burnt annually from natural causes. This area is, however, not distributed uniformly. Fire frequency varies tremendously amongst the various types of vegetation. Factors affecting the probability of occurrence of wildfire and the intensity of any fires that occur include the quantity and spatial distribution of fuel, its moisture content, the local weather and the topography.

Mangroves almost never burn because the litter on the ground is inundated, often twice daily, and is generally too wet. Freshwater swamps, similarly, have free water over the soil surface, but may dry out periodically, particularly during prolonged droughts. The probability of their burning is generally low but variable. Rainforests, by definition, are usually wet, but almost all Australian rainforests have a relatively dry season annually and the intensity of this drought varies between forest types and from year to year. Nevertheless, the incidence of fire in rainforests is generally very low, because the species are not highly flammable and the litter is quickly decomposed.

Sclerophyll forests present a different picture. There is a high production of litter and a low rate of breakdown. The litter, particularly that from eucalypts, is highly flammable and so is the bark and foliage of many of the understorey shrubs and trees. Sufficient fuel is available for fires every 2–3 years, although in many stands it may be too wet to carry a ground fire. Wet sclerophyll forests often build up large quantities of fuel from litter and understorey growth over the period between fires (up

to 400 years) so that when fires do occur, usually in extreme conditions of hot, windy weather after a dry period, the fires are intense. In dry sclerophyll forests, on the other hand, less litter is produced but it usually dries sufficiently to burn each summer, in appropriate weather conditions; the fact that less than 5 per cent of these forests are burnt annually is related to low incidence of ignition and relatively frequent rainfall events.

Woodlands and tropical low open forests accumulate very little litter from one season to the next, and the persistent fuel—branches and dead trees—is not continuous. In the tropics annual grasses contribute most of the fuel, which produces a quick hot fire. In settled areas much of the country is deliberately lit each year, but there are indications that under natural conditions also it is burnt frequently. Outside the tropics the quantity of fuel varies with the seasonal conditions, and fires occur irregularly. In low open woodlands and mallee the ground cover is seldom continuous. Fires in these areas usually result from lightning strikes in dry storms during windy weather; they may occur in early summer but are more common in late summer.

While fires in wet sclerophyll forests occur with low frequency the amount of fuel and the extreme weather conditions ensure that the fires that do occur are cataclysmic. The above-ground parts of most plants are killed and litter, logs and much of the soil organic matter are consumed. Regeneration is almost entirely from seeds, and this results in even-aged stands, not necessarily of the same composition as that which was burnt. Dry sclerophyll forests, because they are made of fire-resistant species, are not killed by wildfires. Regeneration is stimulated, however, and a dense, uneven-aged stand often results. The species composition may change, depending on the intensity of the fire, and those species which depend on fire for seed shedding or germination may be eliminated if fires do not occur. Many species in the dry sclerophyll forests rely on underground organs for survival and the forest recuperates rapidly, but where fires are too frequent (at intervals of 1–3 years) shrubs may be eliminated and replaced by grasses such as *Imperata* species.

The tropical open forests and woodlands, similarly, are composed of fire-resistant species. *Callitris intratropica* is killed by fire but where it grows in dense stands it suppresses ground vegetation and will not carry fire. Several of the *Eucalyptus* species of the tropical open forests have developed extensive rhizomatous systems, but, although they survive the frequent fires, they are not able, in many places, to grow stems tall enough to avoid death of the foliage so that large clonal patches less than 1 m high persist for years. In woodland areas the usually low-intensity fires do not harm the larger trees; although many species of *Acacia* are killed by fires of medium intensity they regenerate from seed or root suckers. Fires in woodlands may stimulate the growth of some shrubs, changing the composition of the stand. Mallee vegetation may carry sufficient fuel to burn at intervals of 7–10 years, but records show that major fires (e.g. 1.5 million ha) occur at intervals of about 100 years in any one district. Small fires (up to 50 ha) evidently occur each year. The above-ground parts of virtually all species are killed but many species, including the mallee eucalypts, survive by lignotubers, while others, such as *Acacia* and *Senna* species, regenerate from seed stored in the soil. Many species of the latter group are relatively short-lived and depend on periodic fire to maintain their presence in the stand.

The low open woodlands of the arid areas behave similarly to mallee, in having very extensive fires at long intervals, when most of the above-ground parts are killed, and the composition of the stands is changed temporarily by the germination of soil-stored seed.

Human-induced changes

Since the arrival of humans, particularly European settlers, in Australia, the pattern of occurrence and intensity of fire has changed dramatically. Aboriginal peoples traditionally used fire for hunting, cooking and to keep warm. There are conflicting opinions about the frequency and extent of uncontrolled fires.

There has undoubtedly been an increase in the occurrence of fire since the advent of white settlers. The introduction of grazing animals reduced the quantity of grass fuel but deliberate annual burning of grass to stimulate new growth has changed the floristic composition, especially of the understorey. Periodic burning at longer intervals, usually to reduce fire hazards, has also changed the composition of the forest but in different directions depending on the frequency of burning. Increased burning also has long-term indirect effects by causing a reduction in soil organic matter and mineral nutrient supply.

Such effects are only one aspect of the impact of human activities on the native flora. Widespread clearing for agriculture or grazing, road construction and power transmission has drastically changed the native vegetation over very large areas. Further changes have been caused by alteration of drainage patterns, river flows, flooding and salt movement, by dam construction and irrigation schemes, and the introduction of many alien herbaceous and arboreal plants. Finally, the escape or deliberate planting of introduced trees such as camphor laurel (*Cinnamomum camphora*), willows (*Salix* spp.), *Mimosa* and *Tamarisk* has dramatically altered the vegetation in many parts of Australia.

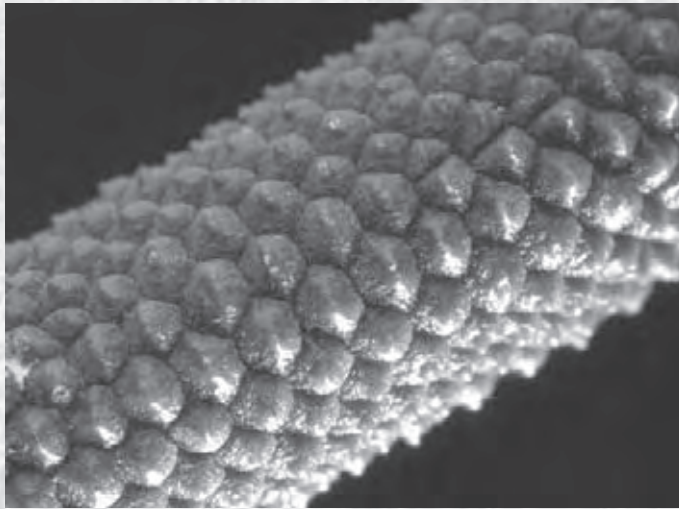


A small remnant of roadside trees of flat-topped yate (*Eucalyptus occidentalis*) near Pingarup in the wheat belt of Western Australia. This is one of numerous species have undergone population fragmentation and subsequent genetic 'erosion' caused by large-scale clearing of native vegetation for agriculture.



Dead river red gum (*Eucalyptus camaldulensis*) trees on a seasonal creek near Oleary, S.A. In some areas, large-scale clearing of native vegetation can cause saline water tables to rise which results in the decline of species not adapted to protracted periods of saline, waterlogged conditions.

GYMNOSPERMS



Kauri Pine Bull Kauri, Bull Pine

Agathis microstachya J.F. Bailey & C.T. White

Kauri pine is a medium-sized to tall tree attaining 50 m in height and 2.7 m in diameter. The trunk is not buttressed and is usually straight with little taper until the start of the crown where there is an abrupt change. It is a tree that can attain massive dimensions.

This species has a very limited distribution being almost confined to the Atherton Tableland of north-eastern Queensland. It is found mainly in the Atherton to Malanda area where it is regarded as a rare species.

Its occurrence is on gently undulating topography. Soils are usually deep loams to clays on granite, metamorphics, acid volcanics or basalt.

While kauri pine grows as an emergent over a variety of rainforest habitats, it often occurs in the interzone between closed rainforests and tall open eucalypt forests. It is associated with a large number of tropical rainforest tree species.

Related species: *Agathis robusta* and *Agathis atropurpurea*. The female cones of *A. microstachya* are more than 6 cm in diameter and contain 160–210 scales per cone while the male cones are sessile, less than 3 cm long, with scales somewhat flattened at the apex and fewer than 500 scales per cone. The female cones of *A. robusta* are more than 8 cm in diameter and contain more than 250 scales per cone (about 340–440) while the male cones are greater than 3 cm long and contain more than 500 scales per cone (about 600–1300). The female cones of *A. atropurpurea* are less than 6 cm in diameter, containing 90–150 scales per cone, while the male cones are distinctly pedunculate with fewer than 500 scales per cone, the scales being slightly rounded at the apex and tending to overlap. Hyland (1978) revised *Agathis* in Australia.

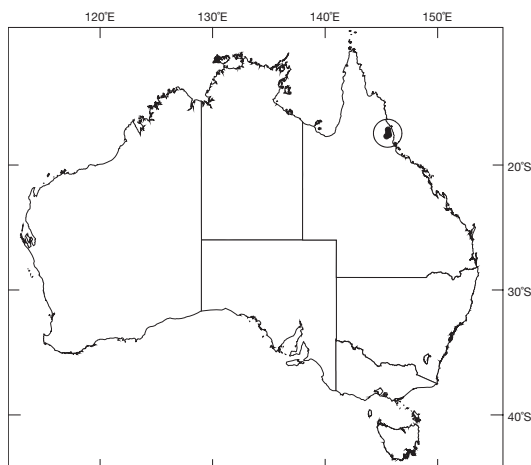
Publication: *Qld Dept Agric. Stock Bot. Bull.* 18, 14 (1916).
Type: Atherton district, northern Queensland, H.C. Mocatta.

Names: Botanical—Greek *agathis* (a ball of thread), an allusion to the globose female cone; Greek *micros* (small) plus *stachys* (ear of corn or a flower spike), alluding to the small male strobili. Common—kauri is the Maori word for *Agathis australis*; pine because it is a conifer.

Bark: Coarsely flaky and brown to grey-brown in colour. The outer blaze is mixed pink and brown; the bark exudate is somewhat milky and has a faint scent (pinene).

Leaves: Cotyledons—2, almost sessile, oblong or ovate, 2.5–3 × 1–1.5 cm, slightly stem-clasping; nervation fine, indistinct, longitudinal, more or less parallel. Seedling—spirally arranged on orthotropic shoots but opposite to subopposite on plagiotropic shoots; leaves on plagiotropic shoots are shortly petiolate (petioles about 0.2 cm long), ovate-lanceolate, acute, 5–8 × 1.5–2.5 cm, with numerous parallel veins, no clear midrib. Adult—as for seedling leaves, petiolate (petioles about 0.1–0.2 cm long), linear to elliptic, 2–9 × 0.5–2.5 cm, stiff; nervation fine, longitudinal, more or less parallel.

Strobili: Male and female strobili are borne on the same tree. Male strobili are shortly pedunculate to almost sessile, 1.1–1.6 × 0.6–0.8 cm, scales 400–500, each bearing 2–5 pollen sacs on the underside. Strobili mature in December.



Cones: Mature cones are globular to ovoid, 7.5–11.5 × 6.5–10 cm, scales 160–210, those from the equatorial section of the cone 2.6–3.5 × 3.3–4.5 cm being generally glaucous at the apex when fresh. Seeds, excluding the wing, are cordate.

Wood: Sapwood is not susceptible to *Lyctus* attack; heartwood is cream to pale brown, growth rings usually inconspicuous. The timber is highly regarded, even in texture, stable, easy to work and polishes well, soft, light and the density range is about 525 kg m⁻³. It is not durable in contact with the ground, but it can be used for veneer, house framing and flooring and also in joinery and allied fields.

Climate: Altitudinal range: 600–1000 m; Hottest/coldest month: 30°C/10°C; Frost incidence: low to moderate (some each year at high elevation sites); Rainfall: 1400–3300 mm per year, summer max.

Distinctive features: Coarsely flaky bark, small male strobili with 400–500 scales, medium-sized cones with 160–210 scales, leaves with numerous fine longitudinal parallel veins.



Agathis microstachya 1. Mature leaves 2. Seedling 3. Female cone 4. Male cones and leaves 5. Male cone 6. Tree butt 7. Tree, Gadgarra State Forest, near Atherton, Qld 8. Close-up of bark 9. Cotyledons on a young seedling

Kauri Pine Kauri

Agathis robusta (C. Moore ex F. Muell.) F.M. Bailey

Kauri pine is a tall tree attaining 50 m in height and 1.8 m in diameter. The trunk is not buttressed and is usually straight with little taper.

This species has a disjunct distribution occurring in southern Queensland between Tewantin and Maryborough and also on Fraser Island and in northern Queensland between the Herbert River and Big Tableland near Cooktown. An old record from the Pioneer River has never been substantiated by subsequent collections and this record is now regarded as suspect. There are two subspecies the typical and subsp. *nesophila*, which occurs in New Guinea.

Soils vary from deep sands on sand dunes (Fraser Island) to shallow or deep well-drained soils on basalt, metamorphic or granite rocks but the species develops best on the latter.

Kauri pine grows as an emergent over a few rainforest types but forms a dominant part of the stand in dry marginal rainforest types on the edge of the rainforest zone. There are a large number of associated rainforest tree species but some of the more obvious in the northern part of its range are hickory ash (*Flindersia iffllaiana*), silver ash (*F. schottiana*), brown tulip oak (*Argyrodendron polyandrum*), mararie (*Pseudoweinmannia lachnocarpa*), flame tree (*Brachychiton acerifolius*), stony backhousia (*Backhousia hughesii*), cadaga (*Eucalyptus torelliana*), candle nut (*Aleurites moluccana*) and *Rhodamnia costata*, while in its southern range common associates include silver ash, mararie, flame tree, iron wood (*Backhousia myrtifolia*), Bennett's ash (*Flindersia bennettiana*) and brown malletwood (*Rhodamnia trinervia*).

Related species: *Agathis microstachya* and *Agathis atropurpurea*. See notes under *A. microstachya*.

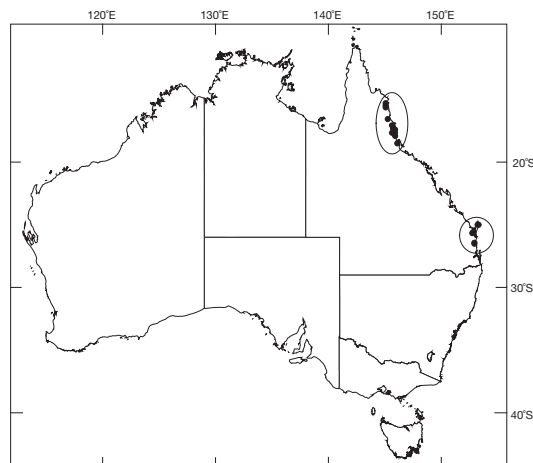
Publication: *Syn. Queensl. Fl.* 498 (1883). Type: Wide Bay, Queensland, C. Moore.

Name: Botanical—Greek *agathis* (a ball of thread), alluding to the shape of the female cones; Latin *robustus* (stout, strong in growth). Common—see notes for *Agathis microstachya*.

Bark: Smooth to slightly flaky and orange-brown, brown or grey-brown in colour. The outer blaze is mixed red, pink and brown and the bark exudate is clear or somewhat milky.

Leaves: Cotyledons—two, almost sessile, oblong or ovate, 3–4 × 1–1.5 cm; veins fine, indistinct, longitudinal, more or less parallel. Seedling—spirally arranged on orthotropic shoots but opposite to subopposite on plagiotropic shoots; leaves entire, shortly petiolate, oblong-lanceolate, acute, 6–7 × 1–2 cm, glabrous, green, shiny above and dull beneath, nervation faint and longitudinal. Adult—as for seedling leaves, petiolate (petioles about 0.3–1 cm long), linear to elliptic, 5–13 × 1–4 cm, stiff; veins fine, longitudinal, more or less parallel.

Strobili: Male and female strobili are borne on the same tree. Male strobili are shortly pedunculate or almost sessile, usually axillary on slender leafy twigs, cylindric, 4–8.5(10) × 7–0.9 cm



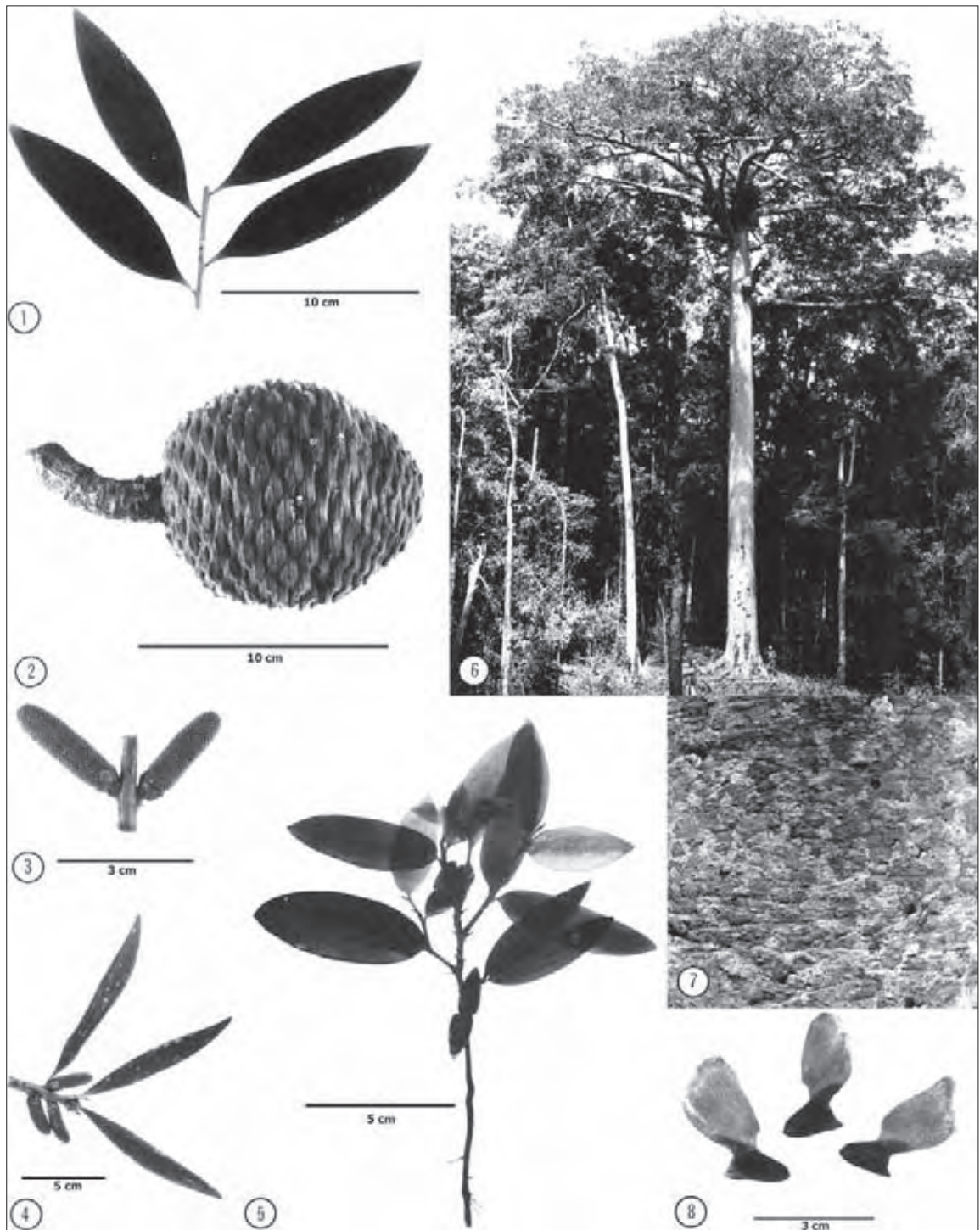
at maturity. Cone scales 600–1300, each with 2–8 pollen sacs on the underside. Strobili mature July–Sept.

Cones: Mature cones are globular to cylindric, 9–15 × 8–10.5 cm, scales 340–440, those from the equatorial section 3.4–4.1 × 3.9–4.6 cm. Seeds, excluding the wings, are narrowly cordate.

Wood: Similar to that of *A. microstachya* (q.v.) but with a density range 410–520 kg m⁻³. Natural stands not in reserves now logged-out and availability is extremely limited.

Climate: Altitudinal range: sea level to 900 m; Hottest/coldest month: 30–32°C/13–19°C; Frost incidence: low; Rainfall: 1100–1800 mm per year, summer max.

Distinctive features: Smooth bark, large male strobili with 600–1300 scales, large cones with 340–440 scales, leaves with numerous fine longitudinal parallel veins.



Agathis robusta 1. Adult leaves 2. Female cone 3. Male strobili 4. Adult leaves and male strobili 5. Seedling with cotyledons 6. Tree, Windsor Tableland, north of Mareeba, Qld 7. Bark 8. Seeds

Bunya Pine

Araucaria bidwillii Hook.

Bunya pine is a tall tree, growing to 30–45 m in height and up to 1.5 m in diameter, with a straight undivided trunk often free from branches for two-thirds of the tree height and showing little taper in this part of the bole. The crown is normally symmetrical and dome-shaped (parabolic), tending to change from a pointed to a flattened apex with age. The branches are themselves unbranched, with the leaves clustered at the ends. As the lower branches die, dormant buds become active at the base of each branch and a secondary, dome-shaped crown may develop below the primary.

Bunya pine mainly occurs in south-eastern Queensland, between Gympie and the Bunya Mountains north-east of Dalby. There are small occurrences in northern Queensland—on Mt Lewis and at Cunnabullen Falls.

This species grows on the ranges within about 160 km of the coast, occupying various topographic positions, from the moist valley floors at low altitudes to ridgetops and upper slopes at higher localities. Many of the soils are red or chocolate loams derived from basalt. It is normally found as an emergent over tropical rain-forest (simple notophyll vine forest), often in association with hoop pine (*Araucaria cunninghamii*). It appears to be fairly frost resistant and has been grown in gardens in Hobart and Canberra.

Aboriginal people used to eat bunya seeds either raw or roasted. Trees with notches in their trunks to assist climbers in obtaining fruits can still be seen at Bunya Mountains National Park. Individual trees were the responsibility of individual tribal members and the right to collect seed was passed from father to son.

Related species: See hoop pine (*A. cunninghamii*).

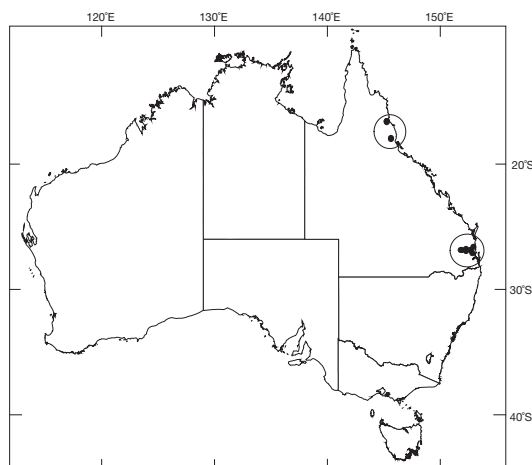
Publication: *Hooker's London J. Bot.* 2, 503–6 (1843). Type: 70 miles north-west of Moreton Bay, Queensland, J.T. Bidwill.

Names: Botanical—*Araucaria*, derived from Arauco, a province of southern Chile, the native habitat of *A. araucana*; *bidwillii*, honours J.C. Bidwill (1815–1853), acting Government Botanist and Director of the Botanic Gardens, Sydney. Common—of Aboriginal origin.

Bark: Persistent over the trunk and branches, with thin scales up to 2.5 × 7.5 cm. The outer surface of the bark is dark brown to black, and the cut blaze is red, grading to orange.

Leaves: Cotyledons—cryptocotylar. Seedling—germinating seeds send down a large tuber from which develops a shoot of spirally arranged leaves, stiff and sharply pointed, glossy green, triangular in section, nervation not visible. Adult—spirally arranged but become two-ranked through twisting of the leaf bases. They are stalkless or very shortly petiolate, lanceolate, sharply pointed, 2–5 × 0.5–1 cm, hard, glossy green, discolorous.

Strobili: Male and female strobili are usually borne on the same tree. Males—up to 20 cm long, produced at the ends of short lateral branches and made up of numerous spirally



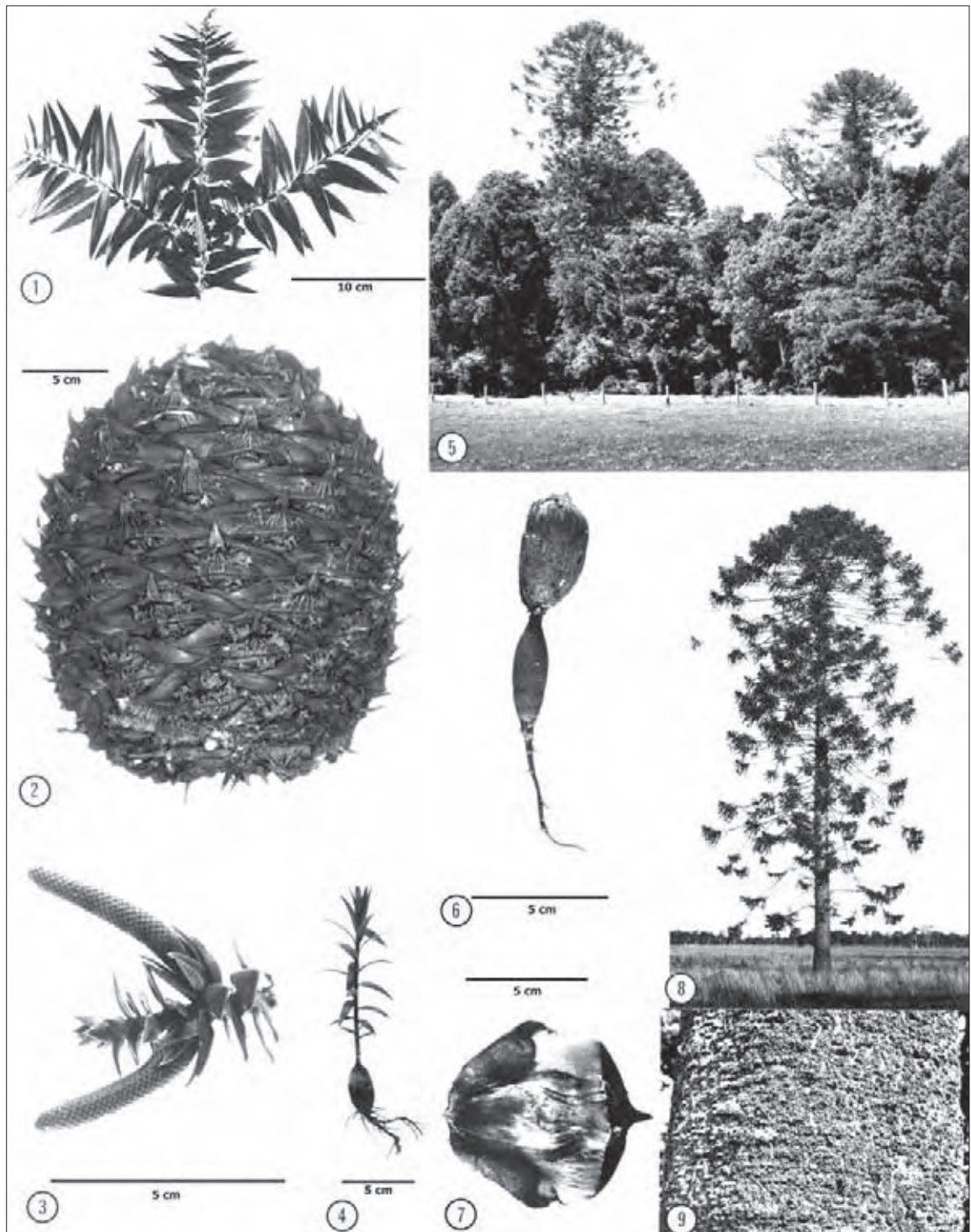
arranged scales, each with a diamond-shaped expanded summit covering about 12 pollen cells. Females—borne on short lateral branches and ovoid, made up of numerous bracts with sharp projections on the outer end; each bract has an ovuliferous scale attached to the upper surface.

Cones: Mature cones are ovoid, very large, up to 20 × 30 cm, with woody scales up to 15 cm broad and bearing a single seed about 5 cm long, loosely united with the scale. The seed is egg-shaped with one end pointed. Germination is hypogeal.

Wood: Very much like that of hoop pine, pale in colour with an even texture and faint growth rings; not susceptible to *Lyctus* attack. Bunya pine is slightly pinker and lighter; the density range 350–550 kg m⁻³, and it is not as strong as hoop pine. Recently recognised as suitable for use in guitar construction as 'soundboards'.

Climate: Altitudinal range: 150–1200 m; Hottest/coldest month: 28–32°C/5–10°C; Frost incidence: low to moderate (up to 30 per year at some sites); Rainfall: 900–2000 mm per year, summer max.

Distinctive features: Bunya pine has a dome-shaped silhouette, which is unique among Australian trees. The cones and seeds of bunya pine are much larger than those of other Australian conifers.



Araucaria bidwillii 1. Adult leaves 2. Female cone 3. Male strobili 4. Seedling 5. Stand, Bunya Mtn, Qld
6. Germinating seed with tuber below and seedcoat above 7. Seed embedded in the scale 8. Tree, cultivated
specimen, between Woodburn and Casino, N.S.W. 9. Bark

Hoop Pine

Araucaria cunninghamii Aiton ex A. Cunn.

Hoop pine is an impressive tree with heights of up to about 60 m and diameters of 0.6 to 1.9 m. A typical tree has a long straight bole with little taper and is free of branches for up to two-thirds of the tree height. The crown is rather open, consisting of dark green foliage tending to be clumped towards the ends of branches. Many trees have long internodes between the whorls of branches, giving a characteristic silhouette of a long spindly leader and whorls of branches with tufts of foliage at the end. Two varieties are recognised, the typical variety and var. *papuana* which occurs in Papua New Guinea.

Var. *cunninghamii* occurs mostly in relatively small patches from the upper reaches of the Macleay River, New South Wales, to Shelburne Bay on Cape York Peninsula, Queensland. The major region is from the Clarence River, New South Wales to near Bundaberg, Queensland. Some stands are on islands but most occurrences are on mountains within 160 km of the sea.

Hoop pine grows on soils derived from a wide range of rock types, from basalt, diorite and limestone, through mixtures of acid phyllites and schists with calcareous sediments or andesites, sandstones with interbedded dolerite and calcareous strata, to recent coastal sands and river alluvia.

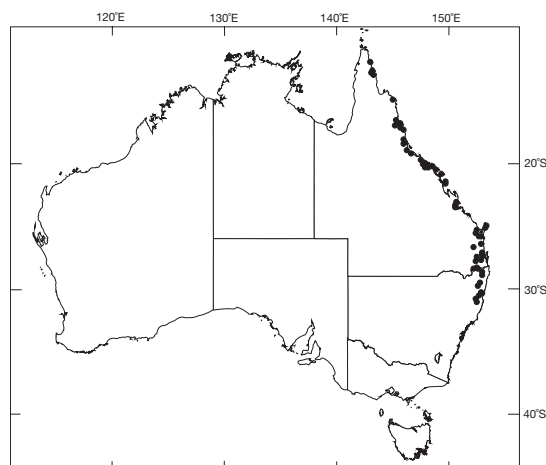
Hoop pines mainly occur as emergent trees in subtropical vine forests. In drier parts of its range hoop pine may occur with bottle tree (*Brachychiton rupestris*), *Flindersia* species and brush kurrajong (*Brachychiton discolor*). On many of the islands off the Queensland coast, hoop pine trees are often rather stunted over dry vine forest. On wetter sites, associated trees include species of *Flindersia*, *Dysoxylum* and members of *Lauraceae* and *Celastraceae*, while on river alluvium hoop pine occurs with black bean (*Castanospermum australe*), brown pine (*Podocarpus elatus*) and silky oak (*Grevillea robusta*). Towards the southern end of its range it is found with coachwood (*Ceratopetalum apetalum*).

Related species: Araucarias are trees of the Southern Hemisphere, occurring in Australia, New Guinea, New Caledonia, New Hebrides and Norfolk Island as well as South America. Hoop pine is related to Norfolk Island pine (*A. heterophylla*), a widely planted ornamental which differs in having a much more formal branching pattern and in having strongly incurved leaves.

Publication: In A.B. Lambert, *Descr. Pinus* 2nd edn, 2, pp. unnumbered (1832). Type: As text: 'But it was not until my visit to the shores of Moreton Bay with the late Mr. Oxley in 1824, ...'.

Names: Botanical—*Araucaria*, derived from Arauco, a province of southern Chile, the native habitat of *A. araucana*; *cunninghamii*, honours A. Cunningham (1791–1839), botanist and explorer. Common—refers to the bark which remains as hoops on the forest floor after the timber has decayed.

Bark: Reddish brown to coppery on young trees and peeling in horizontal strips. On older trees the bark is dark brown or



black, hard and rough with horizontal cracks forming hoops or bands and rectangular scales.

Leaves: Cotyledons—two deeply divided cotyledons giving the appearance of four, each about 3×0.2 cm. Seedling—spirally arranged, narrow to narrow-triangular, scale-like, 0.7–2 cm long, straight and sharply pointed, nervation not visible. Adult—similar to seedling leaves but shorter and tending to be slightly curved, loosely imbricate. The leaves and branchlets are shed as short single units. In some trees pruinose foliage may be evident.

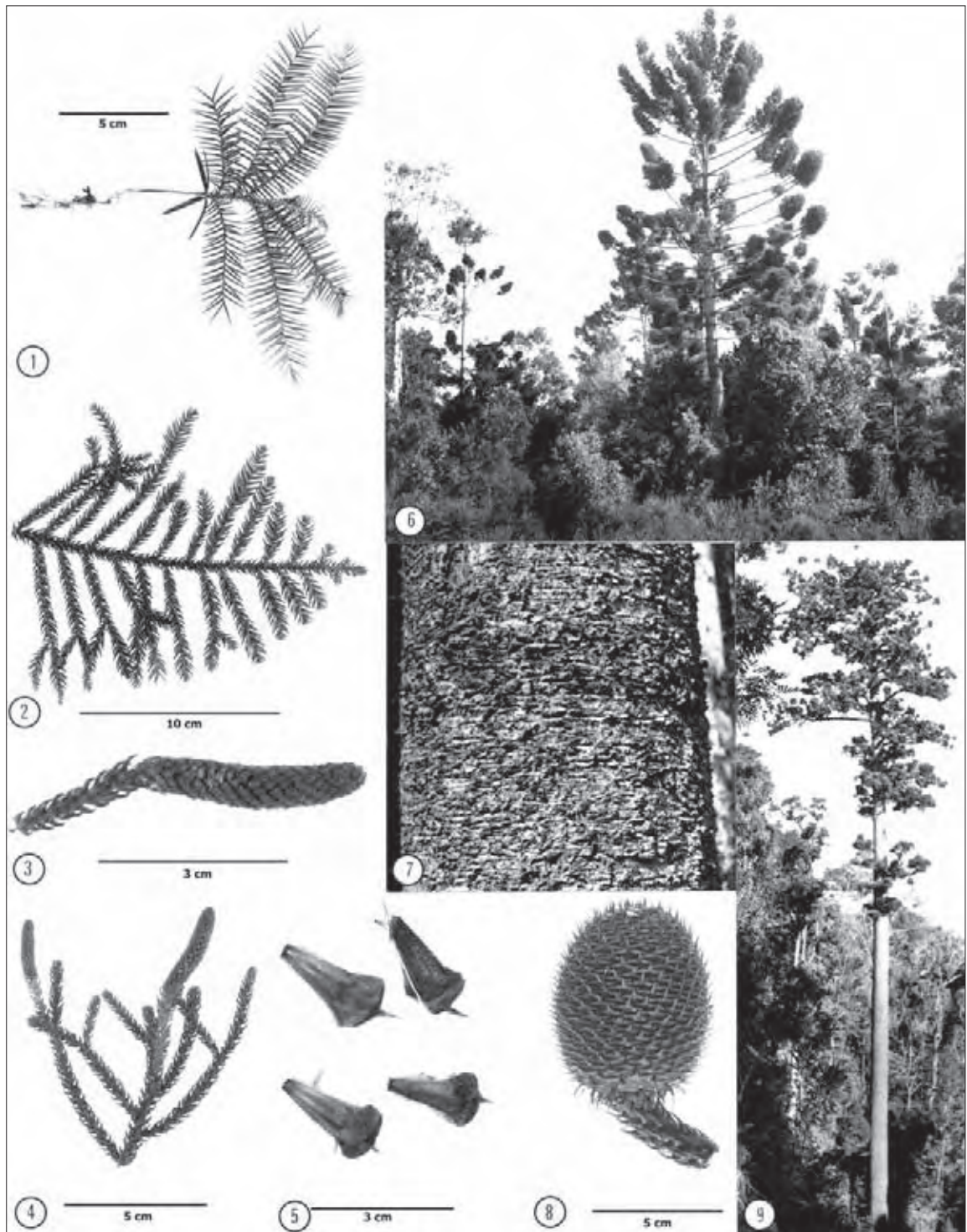
Strobili: Male and female strobili are borne on the same tree. Males—terminal, cylindrical, 4–7.5 cm long, at the ends of twigs and formed of numerous tightly packed scales, each bearing 5–8 pollen cells on the undersurface. Females—globular or ovoid, borne at the ends of short shoots and made up of numerous bracts, each with an ovule-bearing scale fused to its upper surface. Each bract has a stiff, recurved point.

Cones: Terminal, almost globular, up to 10 cm in diameter and composed of flattened, wedge-shaped woody scales with lateral wings. A single seed is embedded in each scale.

Wood: Sapwood, white and 7–15 cm wide, not susceptible to *Lyctus* borers but liable to attack by blue stain fungi; heartwood white to light brown, growth rings indistinct, fine texture and no figure, low strength and durability, soft and low shrinkage; density $410\text{--}610\text{ kg m}^{-3}$. Uniformity of the timber in both appearance and properties is one of its main attributes. In tropical and subtropical regions the timber is also susceptible to attack by hoop pine borers (*Calymnaderus* spp.) unless treated. Hoop pine is used extensively for plywood and as a highly regarded veneer and is an excellent timber for indoor joinery. Large plantations have been established in south-eastern Queensland.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest month: $27\text{--}30^\circ\text{C}/1\text{--}7^\circ\text{C}$; Frost incidence: low to moderate (upland sites); Rainfall: 1000–2000 mm per year, summer max.

Distinctive features: Hoop pine is a tall conifer with dark, rough bark and small linear leaves with sharp points, spirally arranged and grouped at the ends of branches.



Araucaria cunninghamii 1. Seedling 2. Adult leaves 3. Male strobilus 4. Male strobili 5. Seeds 6. Stand, Ulong, near Coffs Harbour, N.S.W. 7. Bark 8. Female cone 9. Tree, Wiangaree State Forest, near Kyogle, N.S.W.

Wollemi Pine

Wollemia nobilis W.G. Jones, K.D. Hill & J.M. Allen

Wollemi pine is an erect tree up to 40 m tall, frequently coppicing from the base. Trunks can be up to 1.2 m in diameter at a third of the height of the tree. The crown is extensive and slender, tapering towards the top. It consists of numerous separate lateral crowns giving a characteristic clumpy aspect to the whole tree. Lateral or primary branches are terminated by male or female cones. As with *Araucaria* the leaves are not shed individually, and entire leafy branches fall and litter the forest floor.

Wollemi pine is one of the world's rarest plants with fewer than 40 adult trees presently known. These occur in two small groves in a remote part of Wollemi National Park, within 200 km north-west of Sydney, in the Central Tablelands of New South Wales. The sandstone massif of the site is crisscrossed with many narrow canyons some only a few metres wide and hundreds of metres deep. The extremely rugged nature of the terrain, coupled with the low fertility of the soils has discouraged exploitation and the area remains undisturbed.

The gorge where Wollemi pine occurs is surrounded by sandstone cliffs of the Triassic Narrabeen Group. The soil is a sandstone-derived, boulder alluvium with high organic matter, some shale component and a substantial basalt wash from higher reaches of small tributary canyons. The local microclimate is wet with a permanent creek.

The Wollemi pines are emergent above temperate rainforest dominated by coachwood (*Ceratopetalum apetalum*) and sassafras (*Doryphora sassafras*). The understorey is dominated by ferns including tree ferns *Dicksonia* and *Cyathea*. Adjacent to the site is tall eucalypt woodland with the most abundant species being Sydney peppermint (*E. piperita*).

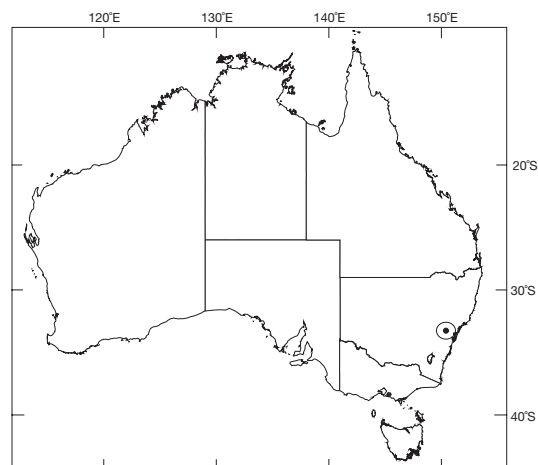
Related species: The Wollemi pine was only discovered in 1994. It belongs to the family *Araucariaceae*, which was previously known to consist only of two extant genera, *Araucaria* and *Agathis*. Fossil leaves of this species were first discovered over 100 years ago in Jurassic sediments deposited 150 million years ago near Gulgong in New South Wales.

Publication: *Telopea* 6, 173 (1995). Type: New South Wales, Central Tablelands, Wollemi National Park, 17 Nov. 1994, W.G. Jones.

Names: *Wollemia*, from the National Park where it occurs, derived from the Aboriginal word *wollumi* (look around you, watch your step), and Latin *nobilis* (noble), alludes to the fine stature of the trees, and intentionally and opportunistically honours David Noble of the New South Wales National Parks and Wildlife Service, who discovered the species.

Bark: Rough bark sheds in thin, papery, fragile, dark red-brown scales from young stems, becoming densely covered on older trunks with soft, spongy nodules or tubercles to 10 mm diam. and 15 mm long.

Leaves: Cotyledons—two, oblong, subsessile, with fine longitudinal nerves. Three subsequent leaf forms: erect shoots—with spirally arranged, narrowly triangular leaves,



0.3–1 × 0.2–0.4 mm. Juvenile and lower canopy shoots—firstly with short, scale-like leaves to 0.3 cm long, then with opposite or subopposite, linear to narrowly triangular, rounded or obtuse leaves up to 8 × 5 cm, broad-based and decurrent, deep green above, pruinose below. Adult shoots—initially near vertical becoming horizontal and later pendulous, with opposite or subopposite, narrowly oblong, rounded leaves in 4 rows, two of longer leaves and two of shorter leaves, up to 10 × 0.8 cm, broad-based and decurrent, coriaceous, dull, light to mid-green. Juvenile and adult leaves dorsiventral and twisted to present upper surface to the sun.

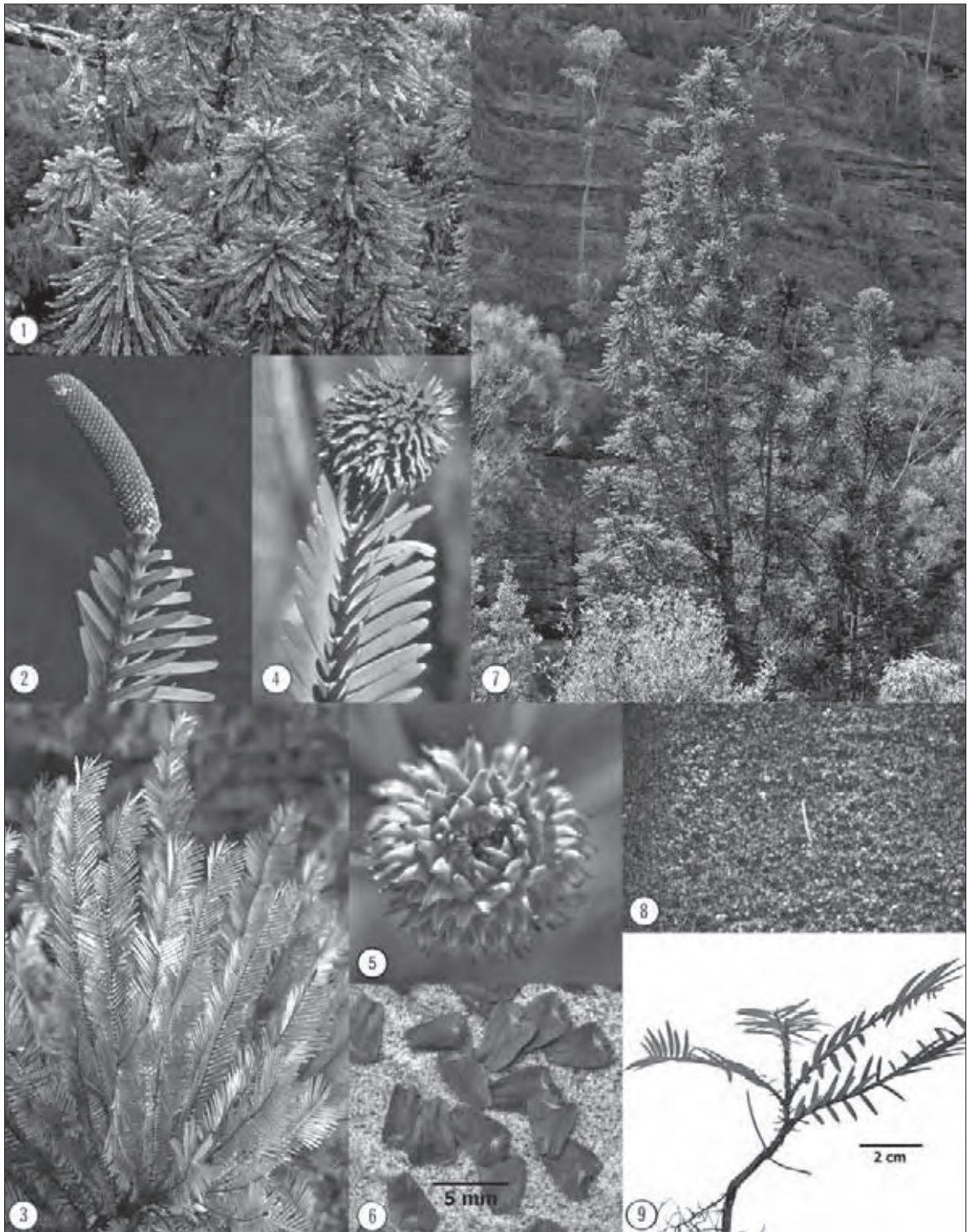
Strobili: Male and female strobili borne on the same tree (monoecious), female above the male. Male—terminal on first-order leafy shoots, to 11 × 1.9 cm, subtended by about 8 spirally arranged, broadly triangular to semi-circular bracts to 0.5 × 0.5 cm; scales greater than 500, with 4–9 pendulous pollen cells on the undersurface. Female—terminal on first-order leafy shoots; bract (ovuliferous) scales greater than 300, to 1.7 × 2.2 cm, and 0.3–0.5 cm thick, bearing a single inverted ovule on the upper surface. Cones are wind-pollinated.

Cones: Globular to broadly ellipsoidal, to 12.5 × 10 cm, mid-green becoming brown; scales finally shedding individually leaving a persistent thick central axis. Seeds—circumferentially winged, to 1.1 × 0.7 cm, wing 0.1–0.2 cm wide. Germination is epigeal.

Wood: In a wood sample taken from single fallen tree the heartwood was light brown, density 570 kg m⁻³ and the anatomy was similar to other *araucarias* (Heady *et al.* 2002).

Climate: Altitudinal range: c. 900 m; Hottest/coldest month: c. 24–26°C/ c. 0–1°C; Frost incidence: moderate to high; Rainfall: c. 800–1000 mm per year, mainly uniform but with a slight summer max.

Distinctive features: A rare erect tree with narrow, columnar crown widest at about one-third of total height. Rough bark of dense, soft, spongy nodules or tubercles. Adult leaves in 4 rows. Male strobili cylindrical, female globular to broadly ellipsoidal.



Wollemia nobilis 1, 7. Saplings (1) and tree (7), Wollemi National Park, N.S.W. 2. Adult leaves and pollen cone 3. Juvenile leaves 4. Adult leaves and mature seed cone 5. Immature seed cone 6. Seed 8. Bark 9. Seedling

King William Pine King Billy Pine

Athrotaxis selaginoides D. Don

King William pine is a medium-sized to tall tree, growing to 30 m in height and 1–1.8 m in diameter (2.2 m has been reported). Trees often have long clear trunks with relatively small, tufted crowns. The bole is frequently forked, fluted, buttressed or curved in a butt sweep, and at higher altitudes trees are reduced to stunted, deformed shrubs, which may nevertheless be over 500 years old. Trees of this species are frequently long-lived.

This species is endemic to Tasmania and occurs in the mountainous region along the north-western and south-eastern margins of the central plateau and from the Mt Field Range to the mountains of the west and south-west.

This species grows on sheltered mid-slopes or valley bottoms on fairly deep soils. Less commonly it occurs on steep rocky slopes and exposed ridges. Soils range from wet peaty clays to texture-contrast types.

King William pine occurs in small stands in cool temperate rainforests (nanophyll moss forests), in association with myrtle beech (*Nothofagus cunninghamii*), southern sassafras (*Atherosperma moschatum*) and celery top pine (*Phyllocladus aspleniifolius*). It is also occasionally found with pencil pine (*Athrotaxis cupressoides*), on stream- or lake-side sites, with eucalypts such as cider gum (*E. gunnii*) or Tasmanian snow gum (*E. coccifera*) in subalpine low open forests, and as subalpine open woodland with a dense understorey of tangle foot (*Nothofagus gunnii*).

Related species: The three species of *Athrotaxis* are confined to Tasmania. *Athrotaxis cupressoides* (pencil pine) grows to about 12 m, in the same general area as *A. selaginoides*. It has leaves about 0.3 cm long, closely appressed to the branchlets. *Athrotaxis laxifolia* is a small tree, which also occurs with the other species and has leaves intermediate in form. The genus *Athrotaxis* was formerly placed in Taxodiaceae but Hill (1998) included this family as part of Cupressaceae.

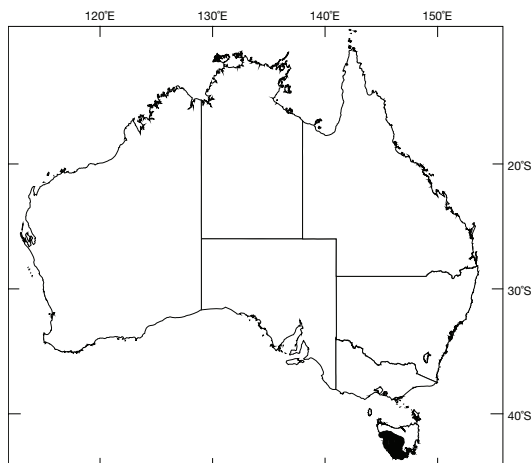
Publication: *Ann. Nat. Hist.* 1, 234 (1838). Type: Van Diemen's Land [Tasmania], 1833, R.C. Gunn 368.

Names: Botanical—*Athrotaxis*, from the Greek *athros* (crowded together) plus *taxis* (arrangement), alluding to the crowded nature of the cone scales; *selaginoides*, derived from *Selaginella*, a club-moss and Greek *-oides* (like), hence with club-moss-like leaves. Common—believed to be either after mountains near where this species occurs or in honour of the 'King' of the Tasmanian Aborigines.

Bark: Retained over the trunk and down to the small branches as a thick soft and spongy layer, which is longitudinally furrowed and slightly fibrous. It is red-brown when cut but the surface weathers to grey-brown in old trees.

Leaves: Seedling—not seen. Adult—spirally arranged, crowded and overlapping on the branchlets, shed with the small branchlets as single units (short shoots). Individual leaves are 1–1.2 cm long, narrow with a sharp point and slightly curved.

Strobili: Male and female strobili are borne on the same tree, at the ends of short shoots. Males—catkins with crowded,



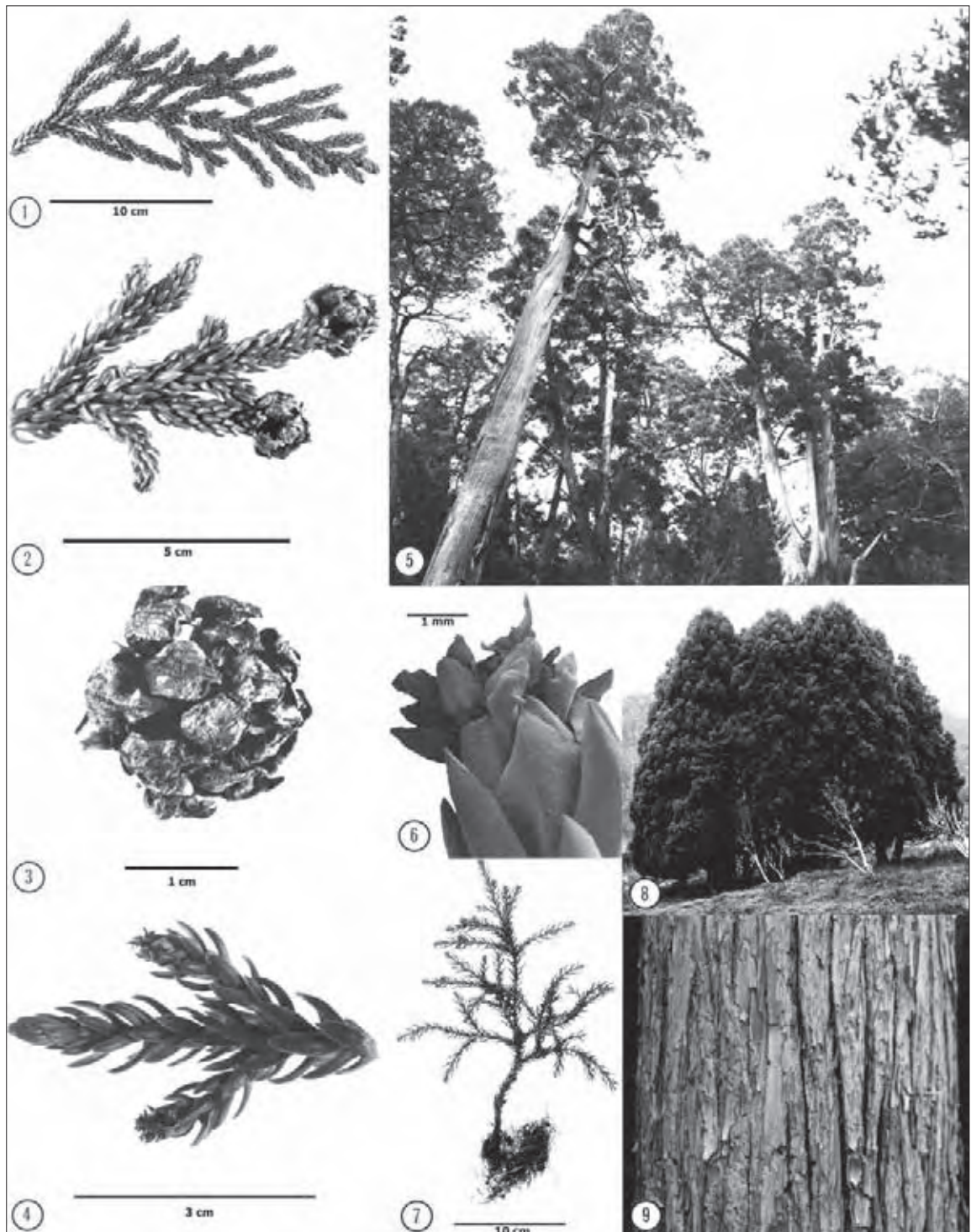
spirally arranged microsporophylls. Females—have up to 25 spirally arranged scales each bearing 3–6 ovules.

Cones: 1.2–2 cm in diameter, with flat woody pointed scales and bearing up to six seeds on the undersurface. Seeds are ovate or oblong with two narrow longitudinal wings.

Wood: Sapwood yellow; heartwood pink to reddish with distinct closely spaced growth rings, very soft with straight grain and fine texture, easily split, density 310–535 kg m⁻³. It has a distinctive scent very similar to Japanese cedar (*Cryptomeria japonica*); good bending properties, works and planes readily, seasons easily with small shrinkage. Timber is very durable and has been dated at ages between 1275 ± 105 and 1715 ± 150 years. Present use is restricted by availability, although small quantities are used in joinery and in boat building. Formerly used in mining operations in western Tasmania. The wood is also popular for beehive boxes because it is light and durable.

Climate: Altitudinal range: 500–1200 m; Hottest/coldest month: 17–20°C/–1–5°C; Frost incidence: moderate to high (upland sites receive heavy snowfalls); Rainfall: 1200–2750 mm per year, winter max.

Distinctive features: Large trees usually have long boles, not especially well formed, with relatively small, densely tufted crowns. Smaller trees can be distinguished from other conifers in the same natural habitat by the 0.5–1.2 cm long leaves, rather stiff and pointed, and by the 1.2–2 cm wide cones.



Athrotaxis selaginoides 1. Adult leaves 2. Adult leaves and female cones 3. Female cone 4. Adult leaves and male strobili 5. Tree, near Cradle Mtn, Tas. 6. Male strobili (S.E.M.) 7. Plant raised from a cutting 8. Trees, near Cradle Mtn, Tas. 9. Bark

White Cypress Pine White Cypress, White Pine

Callitris glaucophylla J. Thomson & L.A.S. Johnson

White cypress pine is a small to medium-sized tree, usually growing to about 18 m tall and 0.45 m in diameter, but occasionally reaching 30 m by 0.9 m. The trunk is usually straight with branch development varying from occurrence over the greater part of the trunk and a dense conical crown for woodland trees, to short branching in the upper trunk only and a relatively flat top for trees in dense stands. The foliage colour is variable but usually glaucous.

This species has a widespread occurrence across Australia south of the Tropic of Capricorn. It extends from central Queensland to Victoria, over most of western New South Wales, with disjunct, sporadic outliers in South Australia and in southern parts of the Northern Territory and Western Australia. The most extensive stands are in the Tambo–Dalby–Inglewood region of southern Queensland and the Baradine–Narrabri and Cobar districts of northern New South Wales.

White cypress pine is found mainly on gently undulating to rolling topography, but extends to lower slopes and rocky hills, which act as fire refugia, in some areas. The species occurs on a wide range of soil types with the most common having a sandy or loamy surface.

It occurs in a range of forest and woodland types over its extensive range. While large areas of more or less pure stands are common, it is also found with a number of eucalypts such as bloodwoods (*E. bloxsomei*, *E. trachyphloia*), ironbarks (*E. crebra*, *E. melanophloia*, *E. fibrosa* ssp. *nubila*), boxes (*E. populnea*, *E. conica*, *E. microcarpa*) and red gums (*E. dealbata*, *E. blakelyi*).

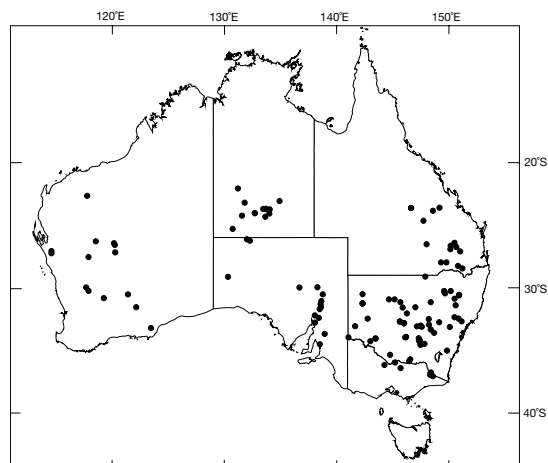
Where white cypress pine occurs in relatively dense stands it suppresses herbaceous ground cover, and its own litter forms a thin mulch over the ground surface. In these conditions the stands will not normally carry fire, but more open stands or those with a large component of eucalypts are more easily burnt and, because this species is very fire sensitive, it may be eliminated from such stands. Susceptible to grazing by stock and rabbits.

Related species: There are 19 species of *Callitris*, which are endemic to Australia and New Caledonia (Hill 1998). Of these white cypress pine is closest to *C. gracilis*, *C. tuberculata*, *C. columellaris* and *C. intratropica*. This species was previously referred to as *C. glauca* (see Thompson and Johnson 1986).

Publication: *Telopea* 2, 731–736 (1986). Type: Noonah Vale, c. 23 km SW of Garah, New South Wales, 5 Oct. 1978, K.L. Wilson 1942.

Names: Botanical—Greek *kallos* (beauty), plus *treis* (three), alluding to a beautifully formed tree with leaves in whorls of three; Latin *glaucus* (bluish grey or bluish green), Greek *phyllon* (leaf) alluding to the glaucous colour of the foliage. Common—white refers to the colour of the foliage; cypress alludes to the similarity of the adult foliage to that of the true cypresses (genus *Cupressus*).

Bark: Persistent to the small branches, hard, deeply furrowed and dark grey, but rather lighter on large trees and often



carrying patches of lichen. The cut blaze is pinkish brown with concentric lines of resin cavities.

Leaves: Cotyledons—two, sessile, linear about 1 × 0.1 cm. Seedling—in alternating whorls of 3–4, linear about 1.2 × 0.1 cm, triangular in section and acutely pointed. Adult—in alternating whorls, they are joined to the stem for most of their length, forming rounded ridges 0.2–0.6 cm, long, with only the pointed tips free; stomata occur mainly in the channels between the adherent parts; there is a small vascular strand at the base of each leaf, with a resin cavity above it.

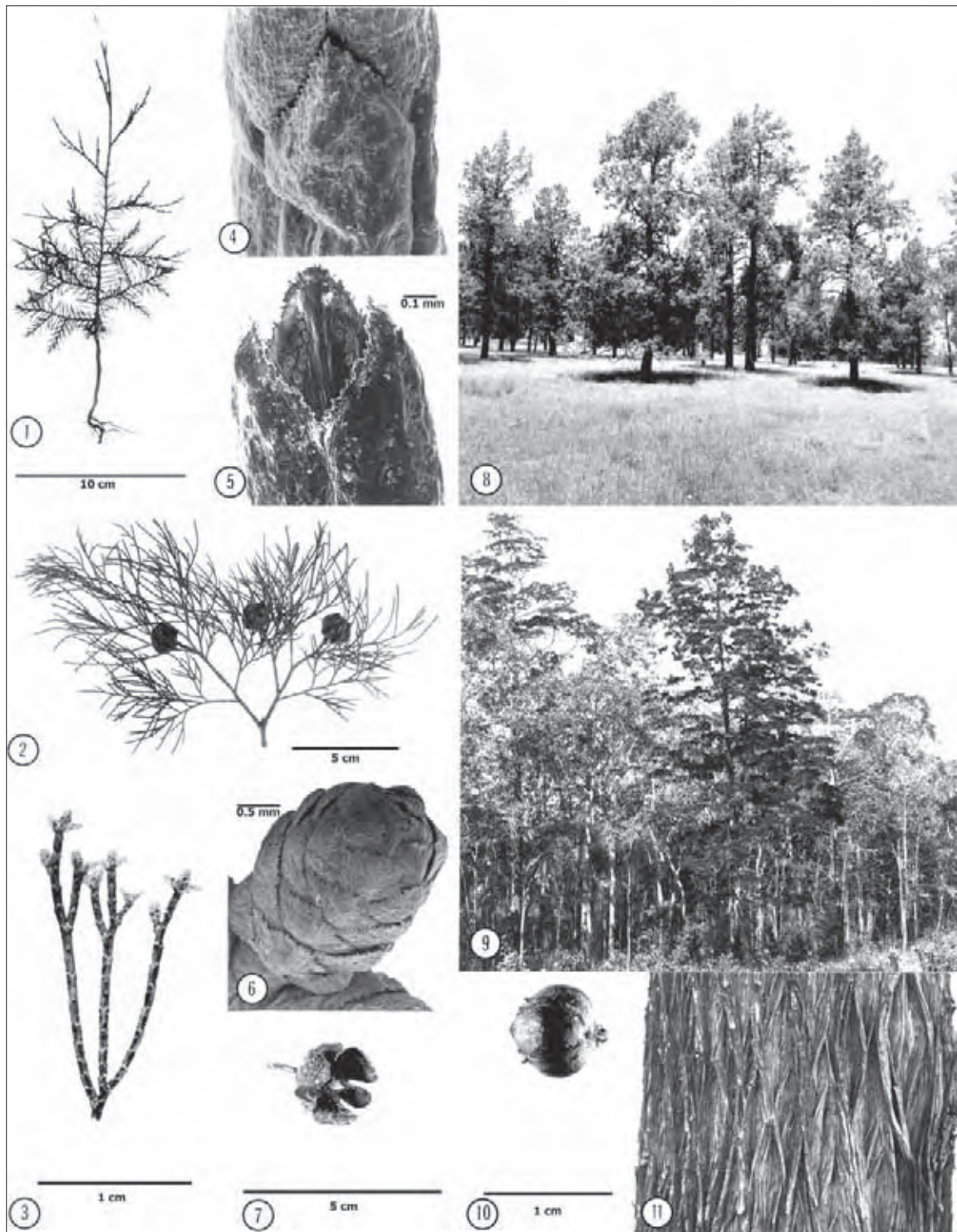
Strobili: Monoecious. Males—borne in threes at the ends of branchlets, cylindrical to ovoid, 0.6–1 cm long, bearing numerous small scales in whorls of 3, each with 2–4 pollen cells. Females—borne on slender stalks on the lower parts of the branches, with 2 whorls of 3 scales, each with several ovules in longitudinal rows on the upper surface.

Cones: Mature cones are spherical, dark brown, 1–2 cm in diameter opening to 1.5–3 cm and consisting of 3 large and 3 small alternating woody scales, slightly wrinkled on the outer surface and bearing a small point near the tip. The cones have a single columella and 18–36 seeds; the number and weight of seeds vary with cone size. The seeds are light brown, 2 or 3 winged, 0.6–0.8 cm wide.

Wood: Sapwood pale and wide, not susceptible to *Lyctus* attack; heartwood light yellow to dark brown with frequent dark brown knots, characteristic resinous scent and slightly greasy feel, fissile, fine texture, very durable, resisting decay and attack by termites and by marine borers *Teredo* and *Limmoria*, rather brittle and tends to split on nailing, density 550–760 kg m⁻³. Unhealthy trees are sometimes attacked by the jewel beetle (*Diadoxus erethurus*). The wood has commercial importance and large quantities are sawn for flooring and lining boards, fencing, poles and posts; wood very similar to black cypress pine (*C. endlicheri*).

Climate: Altitudinal range: 90–350 (–750) m; Hottest/coldest month: 28–32°C/1–5°C; Frost incidence: low to moderate; Rainfall: 220–750 mm per year, uniform to summer max.

Distinctive features: A medium-sized tree with good form and a rather dense crown of scale-like glaucous foliage; cones spherical with 3 large and 3 small valves.



Callitris glaucophylla 1. Seedling indicating difference in morphology between earlier and later formed leaves 2. Fruiting branch 3. Males at ends of vegetative branches 4. Adult stem showing reduced leaves (S.E.M.) 5. Adult leaves exposed at a joint indicating also the stomates (S.E.M.) 6. Male flower (S.E.M.) 7. Open fruit indicating single columella 8. Stand, near Forbes, N.S.W. 9. Tree, *Callitris intratropica* 10. Fruit closed 11. Bark

Brush Cypress Pine

Callitris macleayana (F. Muell.) F. Muell.

Brush cypress pine is a medium-sized to tall tree, growing up to 20–39 m in height and 0.6–0.8 m in diameter, with a long cylindrical bole, spreading branches and light green, fine-textured crown often made up of two types of leaves: the short appressed adult leaves and the persistent, longer, lanceolate juvenile leaves.

This species is found in relatively localised occurrences on the north coast of New South Wales, from just north of Newcastle to south-eastern Queensland. There is then a gap in its distribution and the species occurs in northern Queensland in many locations on the mountain ranges such as at Windin Falls near Atherton and on the Windsor Tableland, west of Mossman.

Although brush cypress pine is fairly widespread in both the southern and northern areas, occurrences are generally restricted to poorer soils or to transitional zones between tall open forest and rainforest. It occurs on various topographies, from gullies at the heads of creeks, through gently sloping sites, to ridgetops. Soils are generally sandy loams to sandy clay loams.

Brush cypress pine is often found with turpentine (*Syncarpia glomulifera*), tallowwood (*Eucalyptus microcorys*) and Sydney blue gum (*E. saligna*); there are local occurrences of flooded gum (*E. grandis*), blackbutt (*E. pilularis*), large-fruited red mahogany (*E. pellita*, *E. scias*), coast banksia (*Banksia integrifolia* var. *compar*) and various rainforest species, particularly in the north.

Related species: *Callitris* is an Australian genus of 19 species; 2 species occur in New Caledonia (Hill 1998). Individual species are rather restricted in distribution, although the white cypress pine (*C. glaucophylla*) extends across southern Australia and *C. intratropica* has a wide distribution in the north.

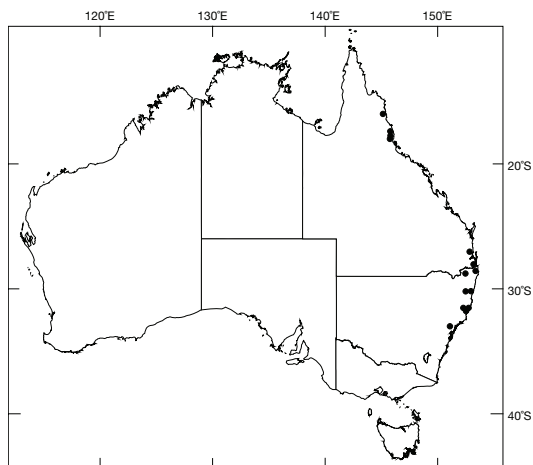
Publication: *Report Burdek. Exped.* 17 (1860). Type: Tacking Point, near Port Macquarie, New South Wales, W.S. Macleay.

Names: Botanical—*macleayana*, honours W.S. Macleay (1792–1865), a colonial naturalist and one-time Trustee of the Australian Museum. Common—brush, alludes to its preference for sites near rainforests (also called brushforests in New South Wales); cypress is a common name for the genus.

Bark: Grey to brown, thick, fibrous and stringy, sometimes scaly. The inner bark exudes resin when cut and has a distinct resinous smell.

Leaves: Cotyledons—sessile, linear. Juvenile—produced in whorls of 3–4 or more and are simple, entire, linear, 0.8–1.5 cm long and sharply pointed, margins recurved, glabrous; these leaves are often produced over much of the crown, particularly in young trees. Adult—alternating whorls of 3 or 4 reduced to scales or teeth 0.3–0.6 cm long; branchlets between the whorls of leaves are angular.

Strobili: Monoecious. Males—borne at the ends of twigs, 0.4–0.8 cm long. Females—borne on short lateral branches, globose, about 0.6 cm in diameter.

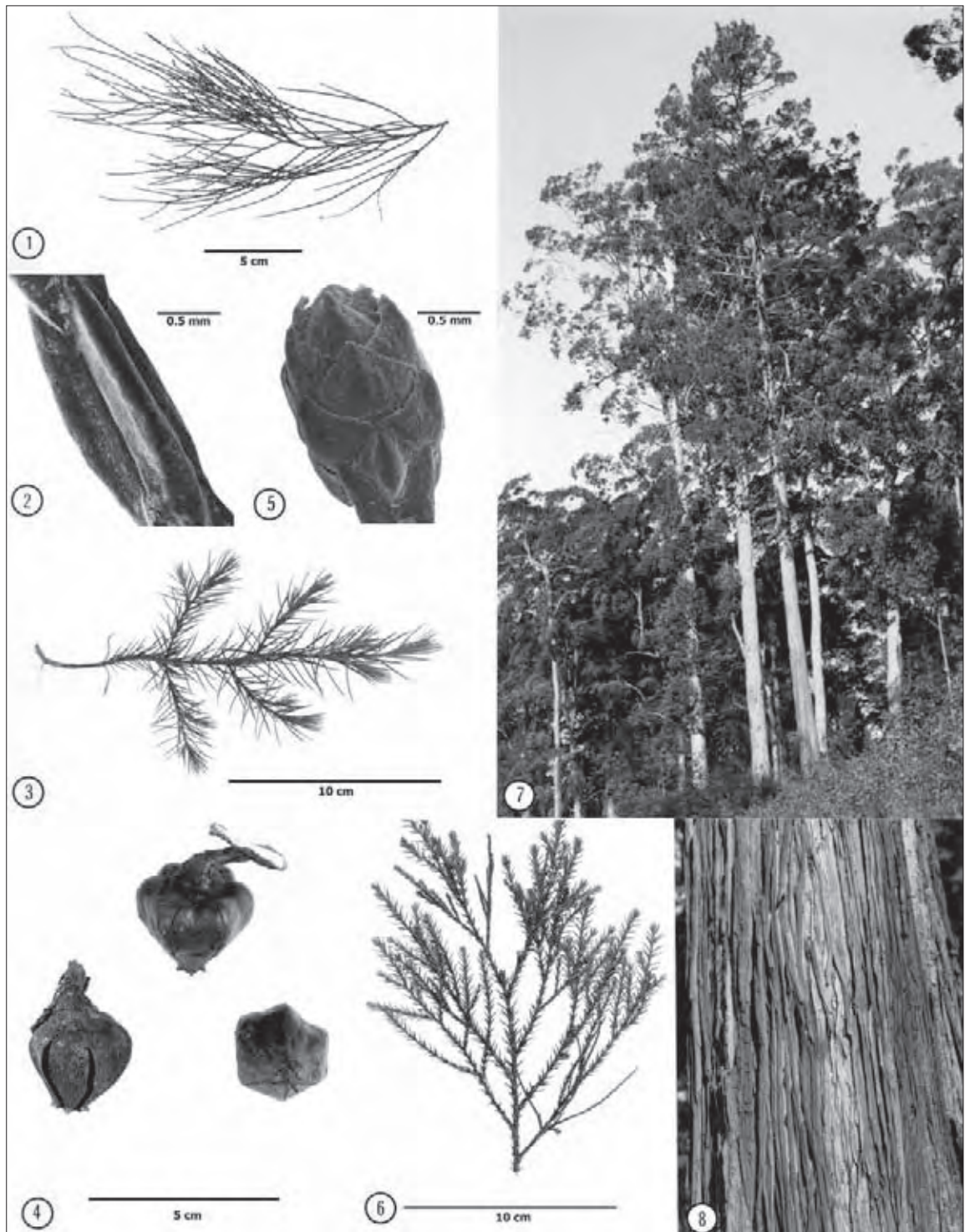


Cones: Dark brown, ovoid or pyramidal, pointed at the tip, about 2.5×2.5 cm, with 6 or 8 valves about equal in size and recurving slightly when the cone opens. Seeds are red-brown, oval, with a single wing.

Wood: Sapwood paler than heartwood, not susceptible to *Lyctus* borer; heartwood light yellow to brown but lacking the dark colour typical of most *Callitris* species, durable, termite resistant and less knotty than inland cypress pines, characteristic resinous scent, density 580 kg m^{-3} . The timber has been used for weatherboards and shingles as well as interior work such as joinery and cabinets.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest month: $25\text{--}32^\circ\text{C}/1\text{--}10^\circ\text{C}$; Frost incidence: low to moderate; Rainfall: 1100–1500 mm per year, summer max.

Distinctive features: This is the only *Callitris* that occurs on rainforest margins. The fibrous bark and large pointed cones with more or less equal-sized valves are also distinctive.



Callitris macleayana 1. Adult leaves 2. Adult stem showing leaf junctions (S.E.M.) 3. Seedling indicating juvenile foliage 4. Fruit 5. Male flower (S.E.M.) 6. Intermediate leaves 7. Stand near Ulong, N.S.W. 8. Bark

Rottnest Island Pine Rottnest Cypress, Maro

Callitris preissii Miq.

Rottnest Island pine is a shrub to medium-sized tree up to 10 m in height and 50 cm dbh. The trunk is usually short boled or comprises multiple leaders from near ground level. Crown branching is ascending and often occurs to near ground level. The crown is much branched and the fine foliage typically very dense.

This species is endemic to coastal south-western Western Australia. It has a restricted occurrence on the Swan coastal plain around Perth and on offshore islands such as Rottnest and Garden Islands.

Rottnest Island pine occurs close to sea level on calcareous sandy soils. Limestone is usually either outcropping or in the lower horizons. It also occurs on sand dune systems and rocky limestone knolls.

This species occurs in woodlands and low woodlands, associated with moonah (*Melaleuca lanceolata*), or occasionally in thickets of *Acacia rostellifera* and *Melaleuca huegelii*, or in pure stands. *Callitris* is fire-sensitive and many stands have been destroyed or extensively damaged. They have also declined or become degraded due to urban development. Undisturbed stands are still extant on Garden Island and Woodman Point, near Fremantle.

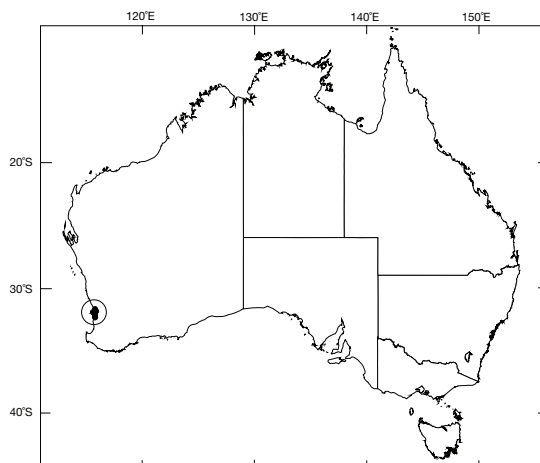
Related species: *Callitris* is an Australian genus of 19 species; 2 species occur in New Caledonia. Following a revision of *Callitris* by Hill (1998), this treatment of Rottnest Island pine has changed substantially from the version given in the 4th edition of this book. Hill recognised *C. preissii* subsp. *verrucosa* at the rank it was assigned in 1860, as *Callitris verrucosa*. It grows on red desert sandhills and extends west from western New South Wales and north-western Victoria, sporadically to the Queen Victoria Desert in South Australia. *Callitris preissii* subsp. *murrayana* was recognised as a subspecies of *C. gracilis*. This taxon mainly grows on alluvial flats of the southern parts of the Murray–Darling River system, extending west to the Flinders and Lofty Ranges and central Eyre Peninsula, in South Australia, and intergrades with subsp. *gracilis* where the two come into contact.

Publication: In J.G.C. Lehmann *Pl. Preiss* 1, 643 (1845). Syntypes: Rottnest Island, Western Australia, L. Preiss 1310; near Rocky Bay and Woodmans Point, Western Australia, L. Preiss 1312.

Names: Botanical—*Callitris*, Greek *kallos* (beauty), and *treis* (three), alluding to a beautiful tree with leaves in whorls of three; *preissii*, honours J.A.L. Preiss (1811–1883) who collected in Western Australia from 1839–41. Common—refers to the natural occurrence of the first described specimen on Rottnest Island.

Bark: Persistent to the small branches, dark grey, irregularly fissured.

Leaves: Seedling—for about 10 nodes the leaves are in whorls of three, narrow, decurrent, needle-like, obtuse, about 1–2 × 0.05–0.1 cm, margins recurved. Adult—scale-like, joined to the twigs for most of their length in alternating whorls of three; each leaf has a cavity containing resin, including pinene, limonene and borneol.



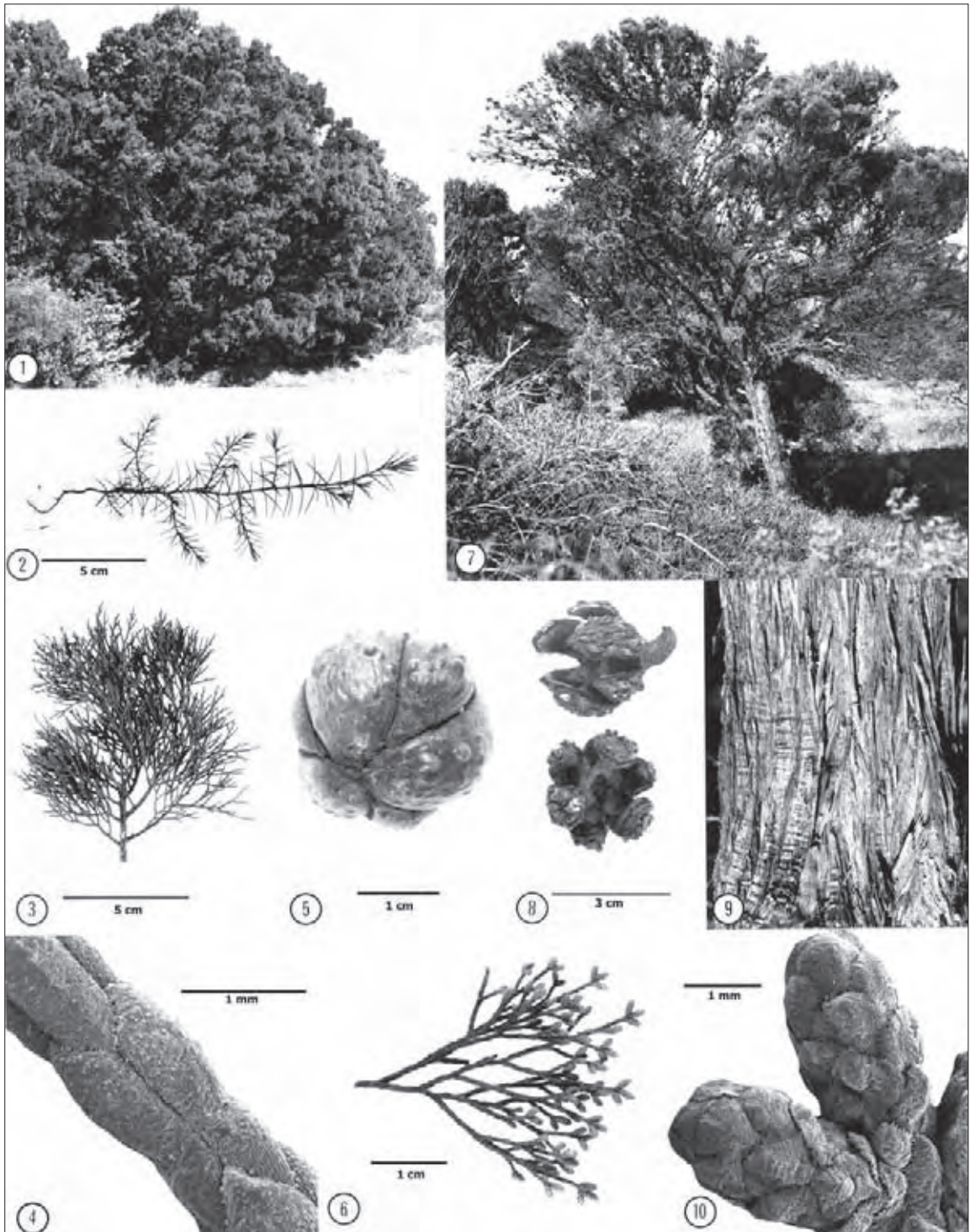
Strobili: Monoecious. Males—clusters of 3 or 4 at the ends of branchlets, cylindrical, to 0.5 cm long with 6 rows of overlapping scales, each bearing 2–4 pollen cells. Females—more or less globular, stalked, sometimes glaucous. Present Oct.–Nov.

Cones: Up to 3 cm broad, depressed globular with thick woody valves, slightly warty. The warts (tubercles) contain resins, which burn readily. Larger valves are blunt, smaller ones pointed, all united at the base on stout stalks. Seeds are light brown, ovoid, with 2 broad wings, c. 0.4 cm wide. Cones are present throughout the year.

Wood: Very similar to other *Callitris* species.

Climate: Altitudinal range: near sea level to 30 m; Hottest/coldest month: 30°C/9°C; Frost incidence: low; Rainfall: 800–900 mm per year, winter max.

Distinctive features: A conifer with small, scale-like leaves with their dorsal surfaces rounded and cones more than 2 cm diameter consisting of 3 large, blunt valves and 3 smaller pointed ones, on stout stalks—often with tubercles.



Callitris preissii 1. Stand, Coogee Beach near Perth, W.A. 2. Seedling 3. Adult foliage 4. Adult stem showing scale leaves (S.E.M.) 5. Closed fruit 6. Males at end of vegetative branches 7. Tree, Coogee Beach near Perth, W.A. 8. Open fruits 9. Bark 10. Male flowers (S.E.M.)

Huon Pine

Lagarostrobos franklinii (Hook. f.) Quinn

Huon pine is a medium-sized to tall tree, occasionally reaching 38 m in height and 1.8 m in diameter, but frequently less than 20 m tall. It usually has a straight trunk, but is often forked in the crown. The trees are not buttressed, and the crown consists of light green weeping foliage.

This species has a limited distribution in south-western Tasmania. The most easterly occurrence is just west of Judbury, towards the confluence of the Huon and Little Denison Rivers—although the species used to grow at Ranelagh.

This species grows along the banks of rivers, on swampy flats or near lakes, usually 'with its feet in water'. Soils along streams are often undeveloped, with pockets of sandy alluvium between boulders, but elsewhere they are peats or peaty clays. Many of the soils seem to have free water in the profile throughout the year.

Huon pine grows in cool temperate rainforest (nanophyll moss forest) associated with myrtle beech (*Nothofagus cunninghamii*), southern sassafras (*Atherosperma moschatum*) and celery top pine (*Phyllocladus aspleniifolius*). Blackwood (*Acacia melanoxylon*) is common on swampy sites. There is often an understorey of laurel (*Anopterus glandulosus*) or horizontal (*Anodopetalum biglandulosum*).

Huon pine is one of Australia's longest-lived species. From the annual rings, the age of trees and logs may be estimated fairly accurately and ages of up to 5000 years are estimated. This species is one of the few conifers that can form clonal thickets by vegetative reproduction; where a branch touches the ground, it becomes covered and forms roots.

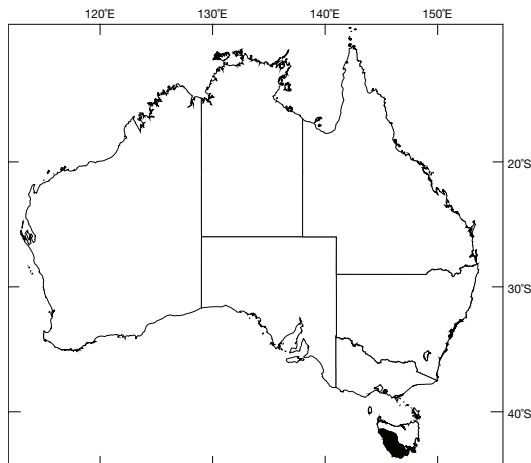
Related species: Huon pine is the only species in the genus *Lagarostrobos*, which is endemic to Tasmania. It was formerly considered to belong to the genus *Dacrydium* of which there are about 20 species, scattered from Malaysia to Chile; of the 7 in New Zealand, rimu (*D. cupressinum*) is the most important timber tree. Podocarpaceae in Australia was reviewed by Hill (1998).

Publication: *Aust. J. Bot.* 30, 316 (1982). Type: Huon River, Macquarie Harbour (*sic*), Tasmania, 1819, R.C. Gunn 1248.

Names: Botanical—Greek *lagaros* (loose), *strobos* (cone), referring to the open structure of the female cone; *franklinii*, honours Sir John Franklin (1786–1847) naval captain, arctic explorer and also governor of Tasmania (1836–43). Common—after the river on the banks of which the species occurs; the river itself was named in honour of Captain Huon de Kermadec, commander of the French ship *Esperance*.

Bark: Light brown in colour and rather scaly.

Leaves: Cotyledons—two, sessile, linear, about 0.2×0.1 cm, blunt tipped. Seedling—spirally arranged, linear, about 0.2×0.05 cm and sharply pointed. Adult—reduced to tiny scale-like leaves, spirally arranged on twigs, keeled on the outer surface and with scattered white stomatal pores; leaf tips are blunt.



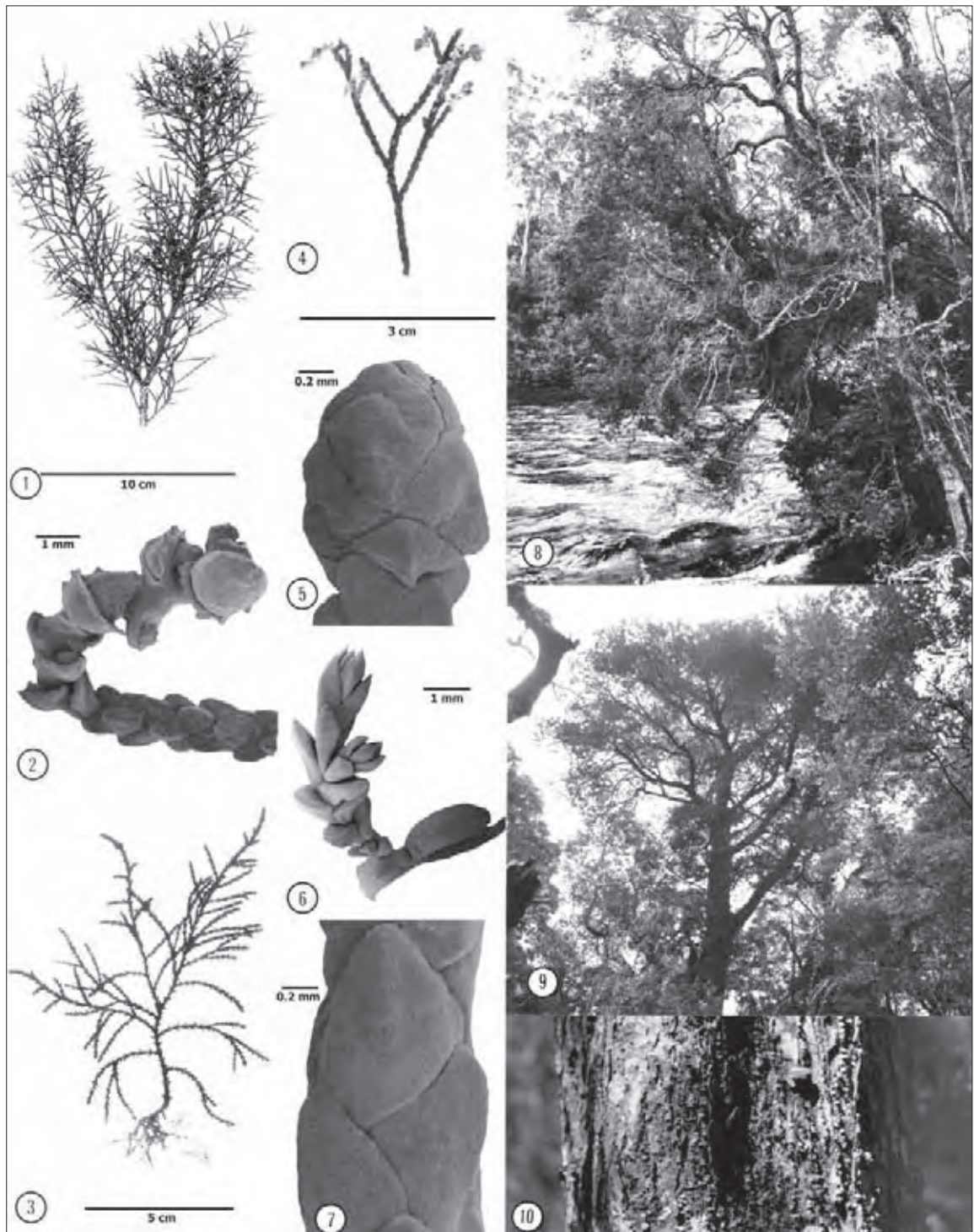
Strobili: Male and female strobili are borne on separate trees. Males—pollen cones are cylindrical, up to 0.5 cm long, on the ends of twigs, with 12–15 microsporangia. Females—consist of 4–8 small scales, one or more bearing a single ovule in a cup-shaped aril.

Cones: Somewhat fleshy when mature, small globular seeds.

Wood: Sapwood pale, not susceptible to *Lyctus* attack; heartwood, light cream to yellowish, with fine and closely spaced annual rings, and sometimes small black 'birds eye' markings from branchlet traces. The timber is very similar to celery top pine (*Phyllocladus aspleniifolius*) and is soft, even in structure, durable, fissile, smooth and oily and light in weight, with density $430\text{--}600\text{ kg m}^{-3}$. The wood has very low shrinkage, is soft, very easy to work and takes a high polish. Huon pine is probably the most durable of Australian timbers, and logs that apparently have lain on the ground for several hundred years are still being harvested and milled. Traditionally, Huon pine has been used for boat building, and several boats built about 1900 are still in active service. More recently cruise vessels over 30 m in length have been built, largely of Huon pine—the *Denison Star* which takes tourists across Macquarie Harbour and up the Gordon River was built of Huon pine cut from the banks of the Denison River. The wood was used for joinery, drafting tables and similar special purposes and now is much sought after for turnery and carving.

Climate: Altitudinal range: near sea level to 1000 m, but mainly below 150 m; Hottest/coldest month: $16\text{--}21^\circ\text{C}/1\text{--}4^\circ\text{C}$; Frost incidence: low to high (snow at upland sites); Rainfall: 1500–3000 mm per year, winter max.

Distinctive features: Huon pine can be distinguished from other Australian gymnosperms in having closely imbricate small leaves (0.1–0.2 cm long), which are strongly keeled, with scattered white stomatal pores on the outer surface.



Lagarostrobos franklinii 1. Adult foliage 2. Females (S.E.M.) 3. Seedling 4. Females on branches 5. Male (S.E.M.) 6. Small seedling with two cotyledons (S.E.M.) 7. Adult leaves (S.E.M.) 8. Tree beside river [photograph courtesy National Parks and Wildlife Service, Tas.] 9. Crown of tree, near Corinna, Tas. 10. Bark

Celery Top Pine

Phyllocladus aspleniifolius (Labill.) Hook. f.

Celery top pine is a medium-sized to tall tree, reaching 30 m in height and 1 m in diameter, but often less than 20 m tall. Although double leaders are fairly common, celery top pine usually has a straight trunk without buttresses, dark bark (often looking black in wet conditions) and a rather dense dark green crown highlighted by the paler leaves of new growth in spring and autumn. The foliage tends to be grouped at the ends of branches.

The main occurrence of this species is in western and south-western Tasmania, with small areas on Maria and Bruny Islands, on the Tasman Peninsula and at Blue Tier in the north-eastern highlands. The species was present on King Island until World War II, after which time it was cleared for soldier settlement.

Much of western Tasmania is mountainous and, although celery top pine is common on undulating country, it occurs on a wide range of topography. Soils range from clays to shallow peats overlying quartzite or schist.

Celery top pine is a common constituent of the Tasmanian cool temperate rainforests (nanophyll moss forests) where it is associated with myrtle beech (*Nothofagus cunninghamii*), southern sassafras (*Atherosperma moschatum*), leatherwood (*Eucryphia lucida*) and blackwood (*Acacia melanoxylon*). It also occurs commonly in the mixed tall open forests (wet sclerophyll forests) where eucalypts such as Smithton peppermint (*E. nitida*), swamp gum (*E. ovata*), alpine ash (*E. delegatensis*), mountain ash (*E. regnans*) or messmate (*E. obliqua*) have an understorey of rainforest trees, and in open forests where it may be associated with trees such as woolly tea-tree (*Leptospermum lanigerum*) and pittosporum (*Pittosporum bicolor*), and shrubs such as horizontal (*Anodopetalum biglandulosum*).

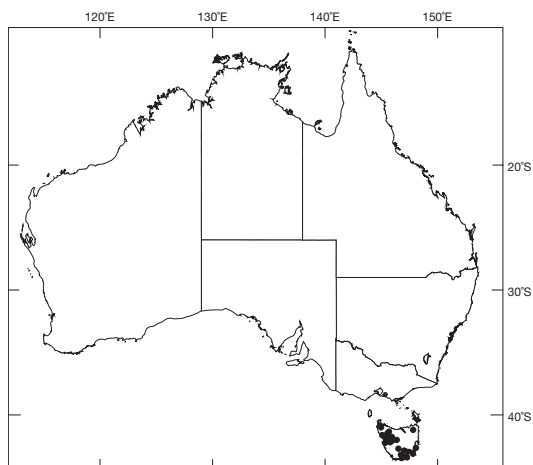
Related species: No other *Phyllocladus* species occur in Australia. The six other species in the genus occur in New Zealand, New Guinea, Borneo and the Philippines. Podocarpaceae in Australia was reviewed by Hill (1998).

Publication: *Hooker's London J. Bot.* 4, 151 (1845). Type: Tasmania, J.J. Labillardière.

Names: Botanical—Greek *phyllon* (leaf), *clados* (a young shoot or branch), alluding to the ‘leaves’ that are flattened branches or cladodes; *aspleniifolius*, after *Asplenium* a genus of fern, plus Latin *folium* (leaf), hence with fern-like leaves. Common—alludes to the similarity of the ‘leaves’ to those of edible celery.

Bark: Dark grey or reddish brown, with many lenticels. On older trees bark is darker and splits into rectangular scales.

Leaves: Seedling—not examined. Adult—reduced to minute scales along the edges of flattened branchlets (cladodes) which are wedge- or diamond-shaped with rounded lobes and small teeth; the surface of the cladodes is dark glossy green with numerous conspicuous veins running from the midrib to the distal margin; oil cavities are numerous.

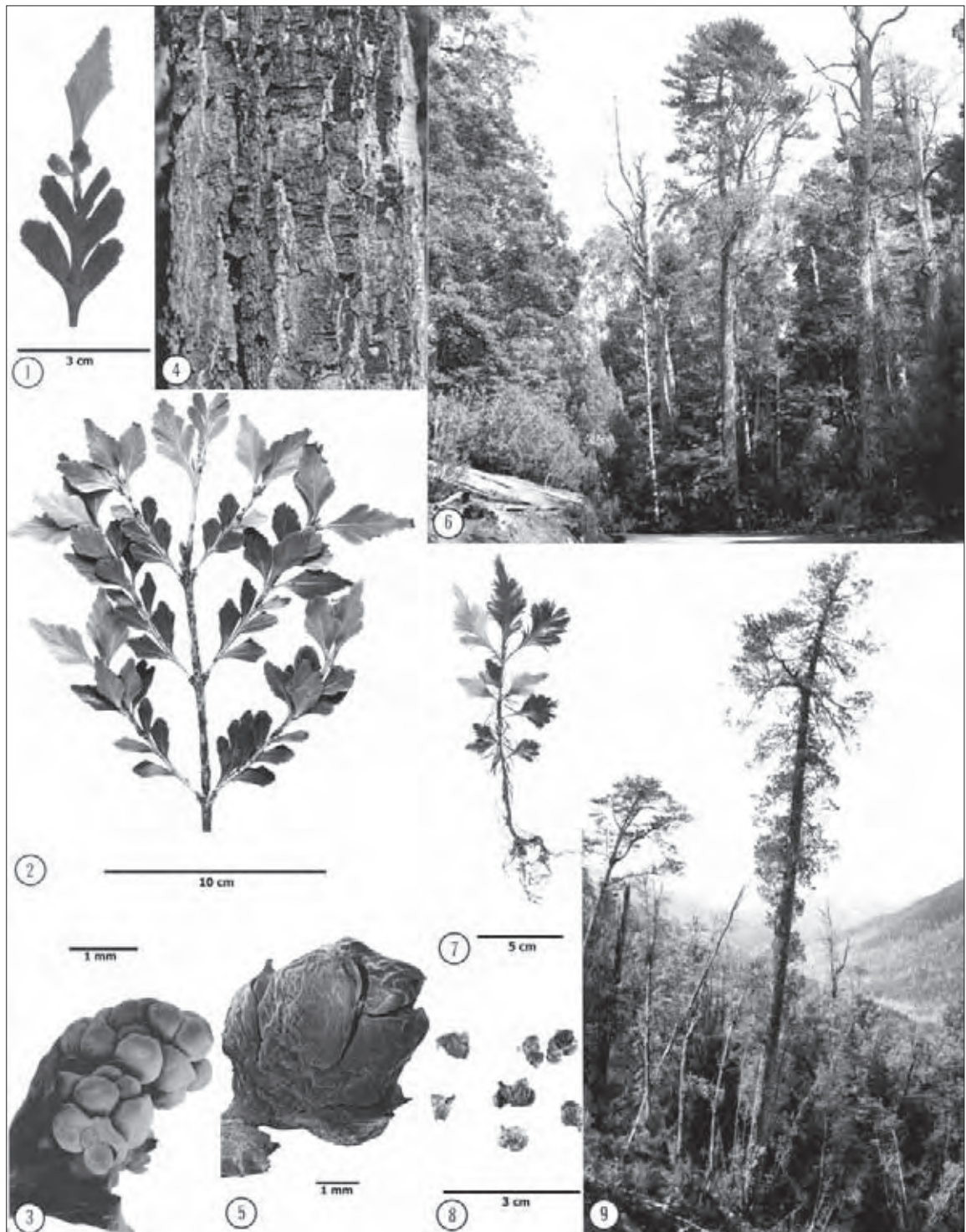


Strobili: Male and female strobili are produced separately, sometimes on separate trees. They are inconspicuous; the pollen cones are cylindrical, up to 0.5 cm long, single or a few together on lateral branches. Female strobili are usually clustered 3 or 4 together in a short spike or on the margin of a cladode. Each strobilus consists of an ovule in the axil of a bract which becomes fleshy and pink to red. The seed on ripening becomes hard and greenish black, surrounded by a white fleshy aril. Seed is extremely difficult to germinate under horticultural conditions, but recently disturbed sites abound in natural regeneration. The species grows readily from cuttings.

Wood: Sapwood and heartwood light cream to very pale brown similar in appearance to huon pine (*Lagarostrobos franklinii*), with fairly easily discernible growth rings, hard, strong with little shrinkage, bends and works well and is very durable, density 510–800 kg m⁻³. It has been used for railway sleepers, strainer posts, boat building, truck and house flooring, joinery and chemical vats. Because this species grows on a wide range of sites and appears to be sensitive to climatic conditions, its patterns of ring width and wood density are being used to investigate past climate.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest month: 18–20°C/0–3°C; Frost incidence: moderate to high (light snowfalls are typical); Rainfall: 1000–3000 mm per year, uniform to winter max.

Distinctive features: A conifer with celery-like ‘leaves’.



Phyllocladus aspleniifolius 1. Cladodes and immature fruit 2. Cladodes from mature tree 3. Males (S.E.M.) 4. Bark 5. Immature fruit (S.E.M.) 6. Stand, Mt Field National Park, Tas. 7. Seedling showing cladodes and leaves 8. Mature fruits 9. Tree, Mt Arrowsmith, near Queenstown, Tas.

Brown Pine She Pine, Yellow Pine, Plum Pine

Podocarpus elatus R. Br. ex Endl.

Brown pine is a medium-sized to tall tree reaching 40 m in height and over 0.9 m in diameter. Tree trunks are often irregularly channelled, spirally fluted or flanged, especially at their bases. The crown is dense and the mature foliage is predominantly dark green, the new foliage in spring being conspicuous because of its lime-yellow colour. The new foliage is soft and stiffens as it ages.

This species occurs more or less continuously from near Nowra, New South Wales, to near the New South Wales–Queensland border. Farther north in Queensland isolated stands occur near Gympie, Proserpine and Rocky River in the McIlraith Ranges near Coen. It is also reported from New Guinea.

Brown pine prefers coastal lowlands where it occurs on deep alluvial soils beside riverbanks.

Brown pine is a rainforest species occurring in sub-tropical rainforests (complex mesophyll vine forests) with associates such as black bean (*Castanospermum australe*), silky oak (*Grevillea robusta*) and in littoral rainforests (mixed notophyll vine forests) with associates such as tuckeroo (*Cupaniopsis anacardioides*), red ash (*Alphitonia excelsa*) and brown laurel (*Cryptocarya triplinervis*). The species also occurs in riverine rainforests with associates such as cabbage-tree palm (*Livistona australis*) and tamarind (*Diploglottis cunninghamii*).

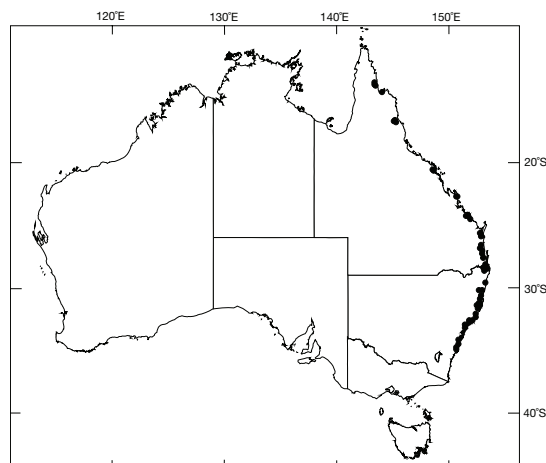
Related species: There are over 100 species of *Podocarpus* in the world and six endemic to Australia: *P. grayi* is a large tree with long, narrow, juvenile leaves which occurs in northern Queensland and Arnhem Land, Northern Territory; *P. dispersus* and *P. smithii* are endemic to the Atherton Tableland region in north-eastern Queensland; *P. drouyniana*, is a small shrub and is restricted to the south-western part of Western Australia. *P. lawrencei* is usually a small alpine shrub occurring in Tasmania, Victoria, New South Wales and the Australian Capital Territory, while *P. spinulosus*, a shrubby species closely related to *P. drouyniana*, occurs in central-coastal New South Wales.

Publication: *Syn. Conif.* 213 (1847). Type: Hunter and Paterson Rivers, New South Wales, R. Brown 3117.

Names: Botanical—*Podocarpus*, from the Greek *pous*, *podos* (a foot), plus *carpos* (a fruit), alluding to the fleshy foot-stalk of the fruit of many species; *elatus*, from the Latin *elatus* (lofty, high, tall), in reference to tree height. Common—refers to the colour of either the heartwood or bark, and because it is a conifer.

Bark: Outer bark is brown to dark brown, usually fibrous and finely fissured but may be scaly on old trees with narrow vertical scales up to 1 cm wide. Blaze on large trees is pink towards the outer margin passing through salmon to brownish shades to the pure white thin inner margin, which turns brown after a few minutes exposure. More than half the bark thickness is composed of dead bark.

Leaves: Cotyledons—two, sessile, linear, about 3–4 × 0.2–0.3 cm, planoconvex in cross-section, dark green. Seedling—apparently in spirals of 4–5 leaves, linear to narrow-lanceolate, about 2 × 0.3 cm, midrib distinct, glossy



dark green. Adult—alternate, shortly petiolate (petioles 0.3 cm long), somewhat distichous, simple, entire, broadly linear-lanceolate, about 4–18 × 0.6–1.2 cm, with a short sharp point at the tip, upper surface shining and smooth dark green, paler undersurface, thick and leathery with recurved margins. Midrib alone distinct but usually raised and more prominent on the upper surface. The winter resting buds consist of several triangular bracts, about 0.2 × 0.1 cm, having aristate apices and thin edges.

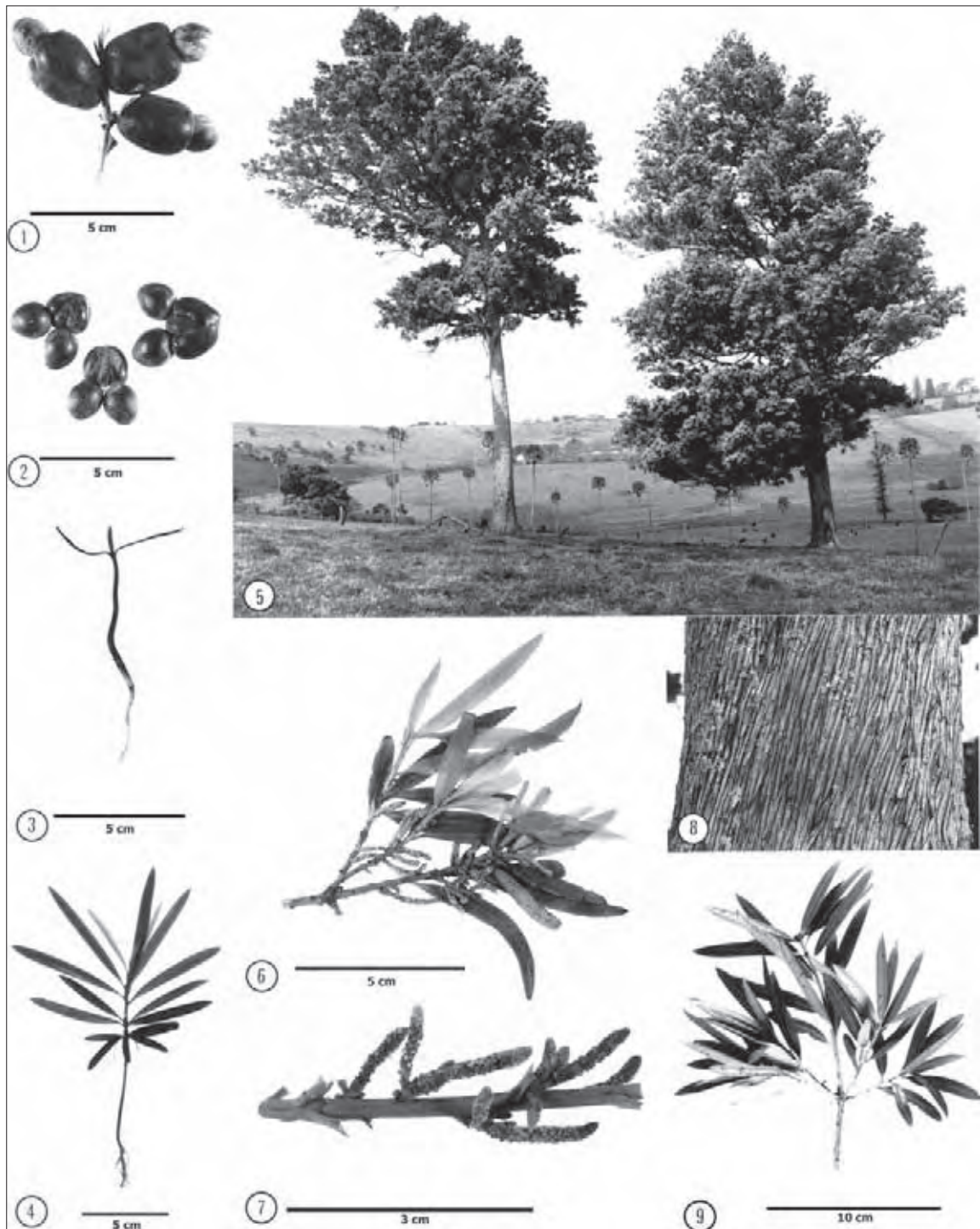
Strobili: Male and females are produced on separate trees. Males—near base of spring foliage in narrow cylindrical catkins, 0.5–2 × 0.1–0.2 cm, arranged in sessile axillary clusters of 2–10; sporangia in pairs, usually separating before dehiscence, dehiscing from the base of the spike upwards, clustered over the catkin spike, scales at base. Females—axillary, pedicellate, consisting of usually one but occasionally more ovules at the end of the very short, special, lateral branches or receptacles, a pair of bracts at the base. Usually only one seed develops to maturity.

Fruits: Immature fruits are green and covered with a waxy bloom, the foot-stalk smaller in diameter than the seed; mature fruits are fleshy and plum-like, bluish black, receptacle up to about 2.5 × 2.5 cm bearing at its summit a slightly fleshy, resinous globular seed, 0.8–1.2 cm diameter. The edible stalk enlarges rapidly and has a mucilaginous texture and a resinous plum-like taste (eaten by Aboriginal people). Seed is enclosed in a woody nut. Mature Mar.–Jul.

Wood: Sapwood not susceptible to *Lyctus* borer, marine borer or termites; heartwood pale brown to brown, highly durable, strong, fine textured, soft, non-aromatic, occasional branch knots adding a silken mottling to the otherwise unfigured wood, density about 600 kg m⁻³. The wood is used for turnery, furniture, joinery, boat planking and piles in salt water.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest month: 24–30°C/5–8°C; Frost incidence: low; Rainfall: 1000–1500 mm per year, mainly summer max.

Distinctive features: A conifer with a dark green crown, long narrow flat leaves, fibrous bark and fruit with fleshy foot-stalks. Fruits used by the native bushfood industry and marketed as 'Illawarra Plum'.



Podocarpus elatus 1. Fruits with single seed 2. Fruits with twin seeds 3. Pair of cotyledons 4. Seedling 5. Trees, near Kiama, N.S.W. 6. Branch with male strobili 7. Close-up of male strobili 8. Bark 9. Adult leaves

ANGIOSPERMS—DICOTYLEDONS



White Cheesewood Milky Pine, Milkwood

Alstonia scholaris (L.) R. Br.

White cheesewood is a medium to large fast-growing tree attaining 35 m in height and 1 m in diameter. The trunk is usually flanged at ground level and these flanges extend for a considerable distance up the trunk. The stem is frequently slightly lobed in cross-section and this causes difficulties in milling.

White cheesewood has a wide distribution in Queensland ranging from near Sarina to Thursday Island. An isolated western occurrence is in Kinrara Crater, east of Einasleigh in north Queensland. The species is also widespread in New Guinea, South-east Asia, India and Sri Lanka.

Soils vary from skeletal to deep well-drained loams on basalt, granite, metamorphic rocks, alluvium and lateritic outcrops.

White cheesewood grows in a wide range of rain-forest types and is associated with a large number of tree species.

Related species: There are about 45 species of *Alstonia* with six species represented in Australia. Close relatives of *A. scholaris* include *A. actinophylla*, hard milkwood (*A. muelleriana*), *A. spectabilis* and quinine (*A. constricta*).

Publication: *On Asclepiad.* 65 (1810). Lectotype: 'Lignum scholare' Rumphius, Amb. 2, 246, t. 82 (1741).

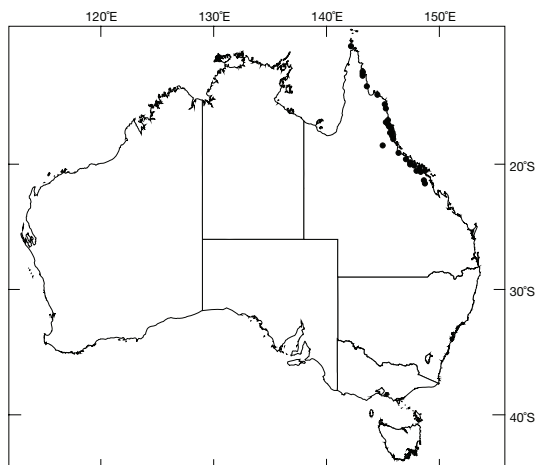
Names: Botanical—*Alstonia*, honours Dr C. Alston (1685–1760), a Scottish physician and professor of botany at Edinburgh University (1716–60); *scholaris*, because of the use of the wood for school boards in Burma. Common—alludes to the creamy, soft, easily cut wood.

Bark: Nondescript to slightly tessellated in texture, cream to yellowish in colour. The outer blaze is cream with a milky exudate that is abundant and flows rapidly.

Leaves: Cotyledons—petiolate (petioles about 0.2 cm long), ovate to elliptical, about 0.5–1.2 × 0.3–0.5 cm, glabrous, green; the cotyledon has a distinct midrib and is similar to later-developed leaves. Seedling—initially opposite, subsequently whorled. Adult—whorled with 4–8 leaves in each whorl, petiolate (petioles 1–1.5 cm long), obovate to elliptical tapering towards the base, 7.5–15.5 × 3–5 cm; lateral veins about 25–40 pairs forming an intramarginal vein close to the edge of the leaf blade.

Inflorescences: Terminal or appearing terminal in the upper axils, panicle, cymose. Flower buds cream, more or less cylindrical; calyx lobes ovate, pubescent, about 0.15 cm long; corolla tube hairy, about 0.9 cm long, lobes pubescent, about 0.4–0.5 cm long overlapping in the bud, throat of the corolla tube closed by a dense ring of hairs. Stamens 5, attached to the corolla tube and alternating with the corolla lobes. Anthers enclosed in the tube. Ovary of two distinct carpels each containing numerous ovules; carpels united only by the style. Stigma thickened, club-shaped (knobkerrie). Flowers Oct.–Dec.

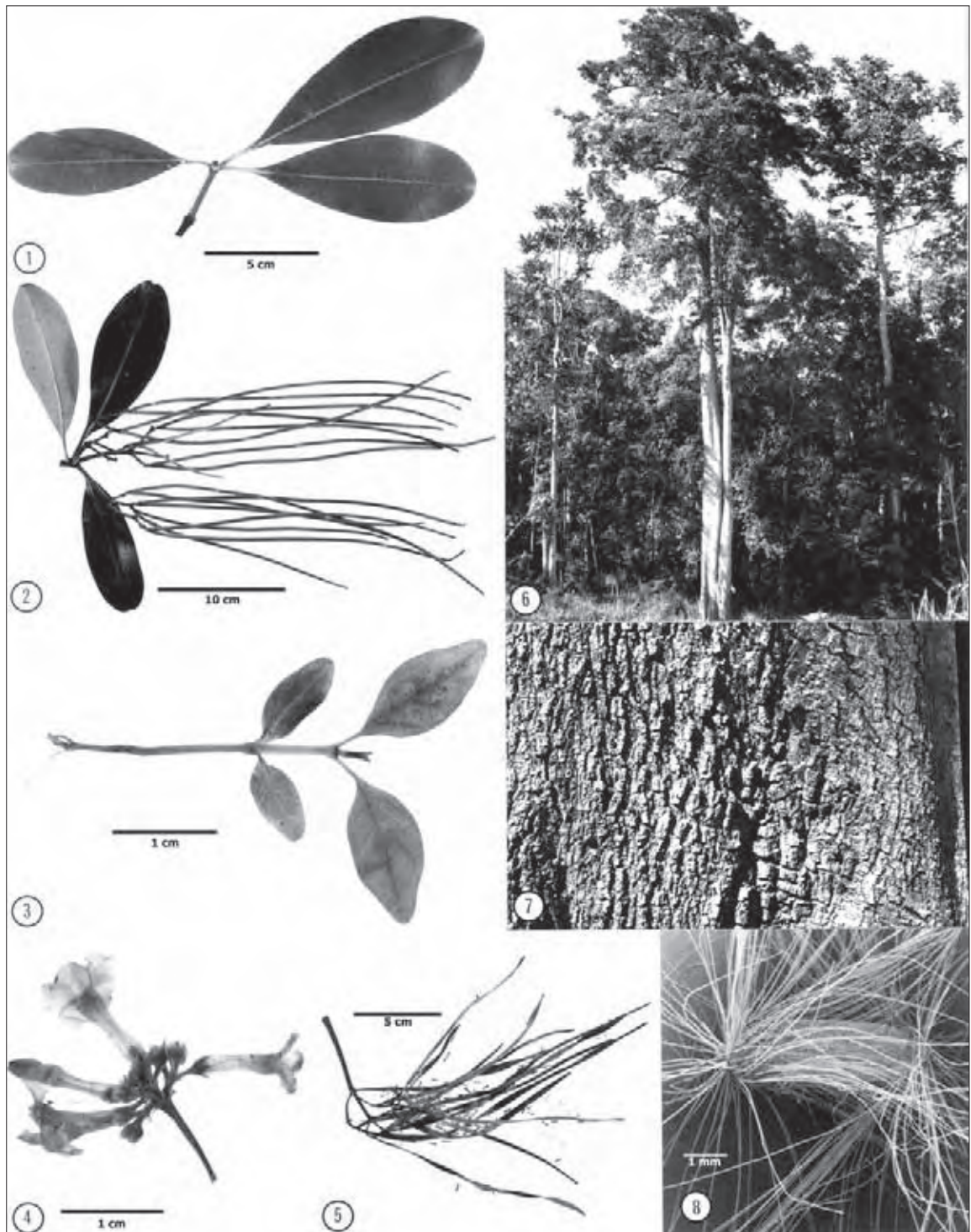
Fruits: Two-lobed pendulous follicles, each follicle up to 30 cm long and containing numerous flat, brown seeds about 0.4–0.5 × 0.1–0.15 cm with a group of fringing hairs to 1 cm long at each end.



Wood: Sapwood susceptible to *Lyctus* attack; heartwood creamy white, soft, uniform in texture, light, density 440 kg m⁻³. Works, carves and dresses well, but is not durable.

Climate: Altitudinal range: near sea level to 450 m; Hottest/coldest month: 30–32°C/13–22°C; Frost incidence: low; Rainfall: 1600–4400 mm per year, summer max.

Distinctive features: Milky exudate from the bark, cream blaze, simple leaves in whorls of 4–8, twigs, petioles and leaves exuding a milky exudate when broken, cream flowers, long narrow bilobed follicles, and seeds with tufts of long hairs at each end.



Alstonia scholaris 1. Adult leaves 2. Adult leaves and roots 3. Seedling 4. Flowers 5. Fruits releasing seeds 6. Tree, Gordonvale, near Cairns, Qld 7. Bark 8. Seed with appendages (S.E.M.)

Grey Mangrove White Mangrove

Avicennia marina (Forssk.) Vierh.

Grey mangrove is usually a small robust tree, 3–8 m in height and 0.2–0.4 m in diameter with some specimens in northern Australia attaining 25 m in height and 1.5 m diameter. The crown is compact, dense, rounded and spreading. Numerous, erect, peg-like aerial roots (pneumatophores) up to 20 cm tall and 1 cm wide (at their bases) protrude through the mud from a horizontal rooting system close beneath. There are three subspecies.

Subsp. *marina* has a discontinuous occurrence in Western Australia from Bunbury in the south to the Kimberley region in the north. Subsp. *eucalyptifolia* extends from near Wyndham in Western Australia to Mackay in Queensland. Subsp. *australasica* extends south from Rockhampton in central Queensland to Ceduna in South Australia.

This species typically occurs around the fringes of coastal estuaries away from the surf. In Australia it occurs throughout the intertidal zone often forming monospecific groves between the extreme landward and seaward portions of the tidally inundated zone. It colonises soils derived from a wide range of substrates, viz. sand, silt and clay. The species often forms monospecific pioneer communities on newly accreting mudbanks in estuaries. Soils are typically moist and have little profile development.

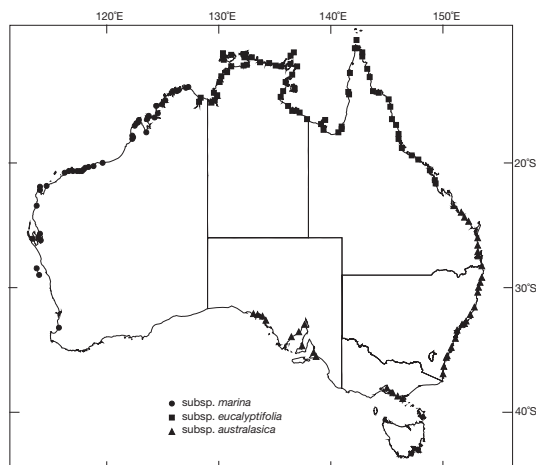
Grey mangrove often grows in low closed forests in dense, pure stands and is a major pioneer species in coastal areas. In southern New South Wales it often grows in association with the river mangrove (*Aegiceras corniculatum*), which is the only other species of mangrove to extend so far south. In northern areas where there may be up to 36 species of mangroves, grey mangrove forms the seaward fringe along gently sloping shorelines, being replaced by other species such as *Rhizophora* spp., *Bruguiera* spp. and *Ceriops* spp. farther inland. In south-eastern Australia it may be associated with swamp oak (*Casuarina glauca*) where the tidal inundation is infrequent.

Related species: Five species in the mangrove genus *Avicennia*, were recognised by Duke (1991). Grey mangrove has affinities with *A. alba* and *A. rumphiana*.

Publication: Subsp. *marina*: In *Denkschr. Kaiserl. Akad. Wiss., Math.–Naturwiss. Kl.* 61, 435 (1907). Type: Arabia, Yemen, Forskal s.n. Subsp. *eucalyptifolia* (Valeton) Everett: *Telopea* 5, 629. Lectotype: Timor, Indonesia, Zippelius s.n. Subsp. *australasica* (Walp.) J. Everett: *Telopea* 5, 628. Lectotype: sheet 14630 (with no annotations), Thunberg Herbarium.

Names: Botanical—*Avicennia*, honours the Persian physician Ibn Sina (980–1037); Latin *marinus* (of the sea). Common—mangrove is a general name applied to species with characteristic root formations, which grow along tidal waterways and other estuarine areas. 'Grey mangrove' refers either to the distinctive colour of the undersides of adult leaves or to the colour of the bark.

Bark: Fissured, pustular, light grey or brown (*australasica*) or smooth, green to chalky white (*marina*, *eucalyptifolia*) often with thin, stiff, brittle flakes giving older trees a rather scaly, fissured appearance. Blaze thin bark and white sapwood.



Leaves: Cotyledons—shortly petiolate, with one cotyledon folded and clasping the other folded cotyledon in a D-shaped formation about 3 × 2.5 cm; cotyledons remain folded while seedling germinates; large, fleshy, and when unfolded, reniform, about 2.5 × 5.5 cm; hypocotyl glabrous but root collar consists of a mass of brown hairs to 0.3 cm long. Juvenile—opposite, petiolate, lanceolate. Adult—opposite, petiolate (0.8–1.2 cm long), thick, ovate-elliptic (*marina*, *australasica*) or lanceolate to narrowly lanceolate (*eucalyptifolia*), about 4–9 × 2–4.5 cm, bright green and glossy above and white or grey and hairy underneath. The leaves are palatable to stock.

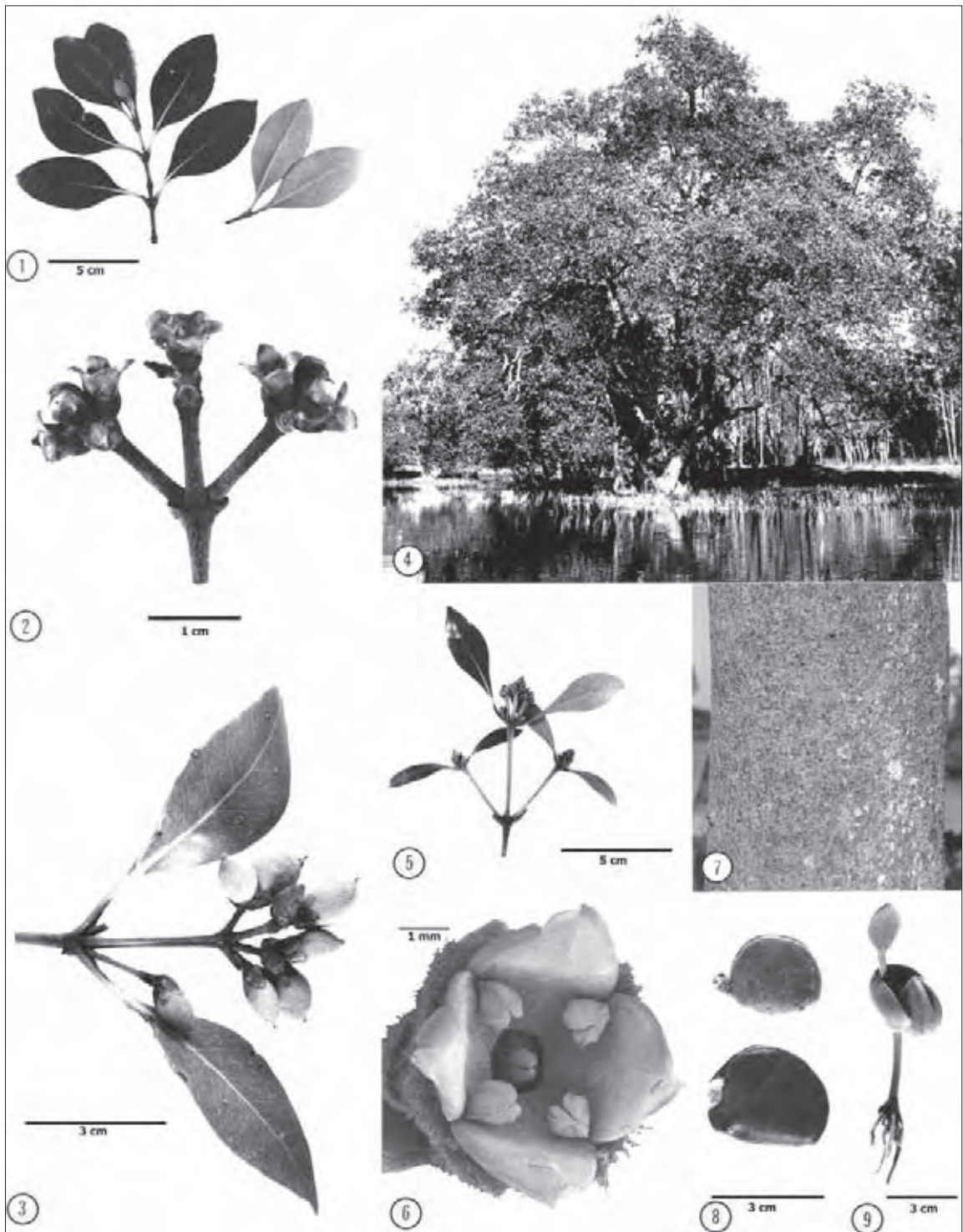
Inflorescences: Small dense cymes, 3–5 flowers each, on angular peduncles 1–1.5 cm long. Flowers, fragrant with a winelike scent, small, up to 0.8 × 0.5 cm. Calyx lobes small, 5 imbricate segments, outer surface hairy (*australasica*) or glabrous with basal hairs (*marina*, *eucalyptifolia*). Corolla tubular, orange, nearly twice as long as the sepals, finally dividing into 4 ovate lobes, 0.3–0.4 × 0.3–0.4 cm, almost glabrous upper surface, hairy beneath. Stamens 4, with anthers large relative to the short filaments, which are adnate to the corolla between petaloid lobes. Ovary superior, hairy and globular, style glabrous with 2 stigmatic lobes. Flowers Jan.–Jun. (*australasica*), Nov.–Feb. (*eucalyptifolia*), Dec.–Mar. (*marina*).

Fruits: Two-valved capsules, small, ovoid, about 5 × 3 cm, yellow just before falling, containing one seed. Seedcoat thin with a sandpaper texture. Fruit mature Apr.–Feb. (*australasica*), Mar.–Apr. (*eucalyptifolia*), Mar.–Nov. (*marina*). Fruits dispersed by tidal action, occasionally viviparous.

Wood: Sapwood pale, not susceptible to *Lyctus* attack; heartwood greyish, extremely tough, hard, conspicuous brown growth rings, density about 880 kg m⁻³; used for knees and elbows in boat building.

Climate: Altitudinal range: sea level; Hottest/coldest month: 25–34°C/5–19°C; Frost incidence: nil or rare; Rainfall: 200–2500 mm per year, mainly summer max.

Distinctive features: A tidal foreshore species with leaves that are grey underneath and shiny green above. Pencil-thin pneumatophores.



Avicennia marina 1. Adult leaves indicating the grey undersides 2. Inflorescence 3. Fruiting branch 4. Tree (subsp. *australasica*), between Macksville and Nambucca Heads, N.S.W. 5. Floral buds indicating the shape of the inflorescence 6. Flower (S.E.M.) 7. Bark 8. Seeds 9. Seedling showing one cotyledon clapsed inside the other

Boab Baobab, Bottle Tree, Dead Rat Tree, Gadawon

Adansonia gregorii F. Muell.

Boab is a small to medium-sized tree reaching 9–12 m in height. Trunks of individual trees commonly have spectacularly large, swollen bases that are barrel- to bottle-shaped and up to 15.7 m in circumference. Trees are deciduous during the dry winter period and the new leaf, produced in late spring and early summer, forms an attractive light green canopy of finger-like leaves. Canopies of younger trees are broadly conical and extremely dense compared with those of older trees, which are umbrella-shaped and sparse. Large terminal white flowers appear while the species is in leaf but the trees are often leafless when in fruit. Large trees are believed to be of great age.

This species occurs in the Kimberley region of Western Australia where its distribution extends from near Broome, Western Australia, to the Fitzmaurice River region, north of the Victoria River estuary, Northern Territory. Populations do not usually extend far inland but large populations occur about 300 km inland in the Glenroy and Tablelands areas.

Boab is common on the plains of the Ord and Fitzroy valleys, on rocky outcrops and on the limestone hills of the Oscar and Napier Ranges. The species is common on the Cockatoo Sands and other light textured soils around Kununurra but also grows on soils derived from sandstone and basalt.

Boab occurs in open woodlands where individual trees are usually spaced widely apart. Occasionally small copses of boabs occur and these are usually the result of regeneration from one or more parent trees. In addition, boab is occasionally distributed along creek lines. Bloodwood eucalypts are common associates while the understorey contains numerous species of grass.

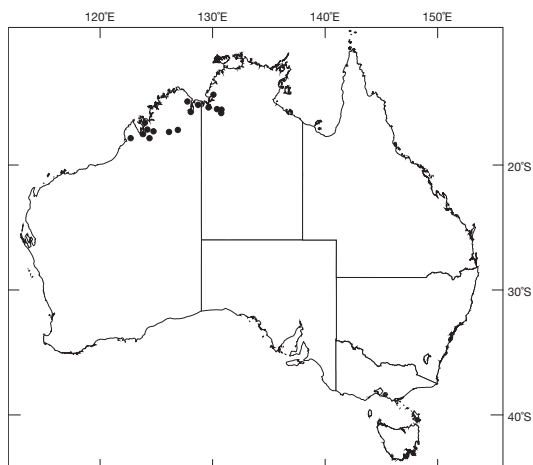
Related species: There are three species of *Adansonia*, viz. *A. digitata* of Africa, *A. madagascariensis* of Madagascar and *A. gregorii*.

Publication: *Hooker's J. Bot. Kew Gard. Misc.* 9, 14 (1857).
Type: collected beside the Victoria and Fitzmaurice Rivers and Point Pearce, Western Australia by A. Cunningham.

Names: Botanical—*Adansonia*, honours M. Adanson (1727–1806), a French naturalist and explorer who first discovered the African baobab (*A. digitata*) in 1748; *gregorii*, honours A.C. Gregory (1819–1905), who explored north-western Western Australia, Queensland and the Northern Territory. Common—after the common name for the African baobab (*A. digitata*), boab being a shortened version of baobab.

Bark: Smooth surfaced, somewhat shiny, often pock-marked especially on very old trees, dull grey. The bark retains inscriptions for long periods as demonstrated by the inscription 'H.M.C. Mermaid 1820' which was carved on an old boab trunk and is still legible today.

Leaves: Cotyledons—petiolate to 0.4–0.5 cm long, broad-ovate to 4 × 4 cm, light green, large and crumpled in the seed-coat, 7–9 digitate veins, glabrous; junction of radicle and hypocotyl is swollen. Seedling—first pair alternate, petiolate to 1 cm long, lanceolate, up to 3.5 × 1 cm,



discolorous; subsequent pairs, alternate, petiolate, digitate to 6 leaflets with some leaflets lobed, individual leaflets oblanceolate about 5–6 × 1–3 cm, midrib raised and prominent beneath; pair of deciduous, subulate, stipules about 0.3 × 0.1 cm, at base of each leaf. Adult—alternate, petiolate to 7–11 cm long, petioles terete and slightly swollen at bases; digitate, to 7 leaflets, leaflets shortly petiolate (petiolules 0.1–0.3 cm), broad-lanceolate to obovate with larger leaflets from 9–11 × 3–4 cm but with smaller basal leaflets much reduced, being about 6 × 2 cm; bright green above and dull beneath, glabrous, discolorous; nervation highly reticulate, midrib raised beneath.

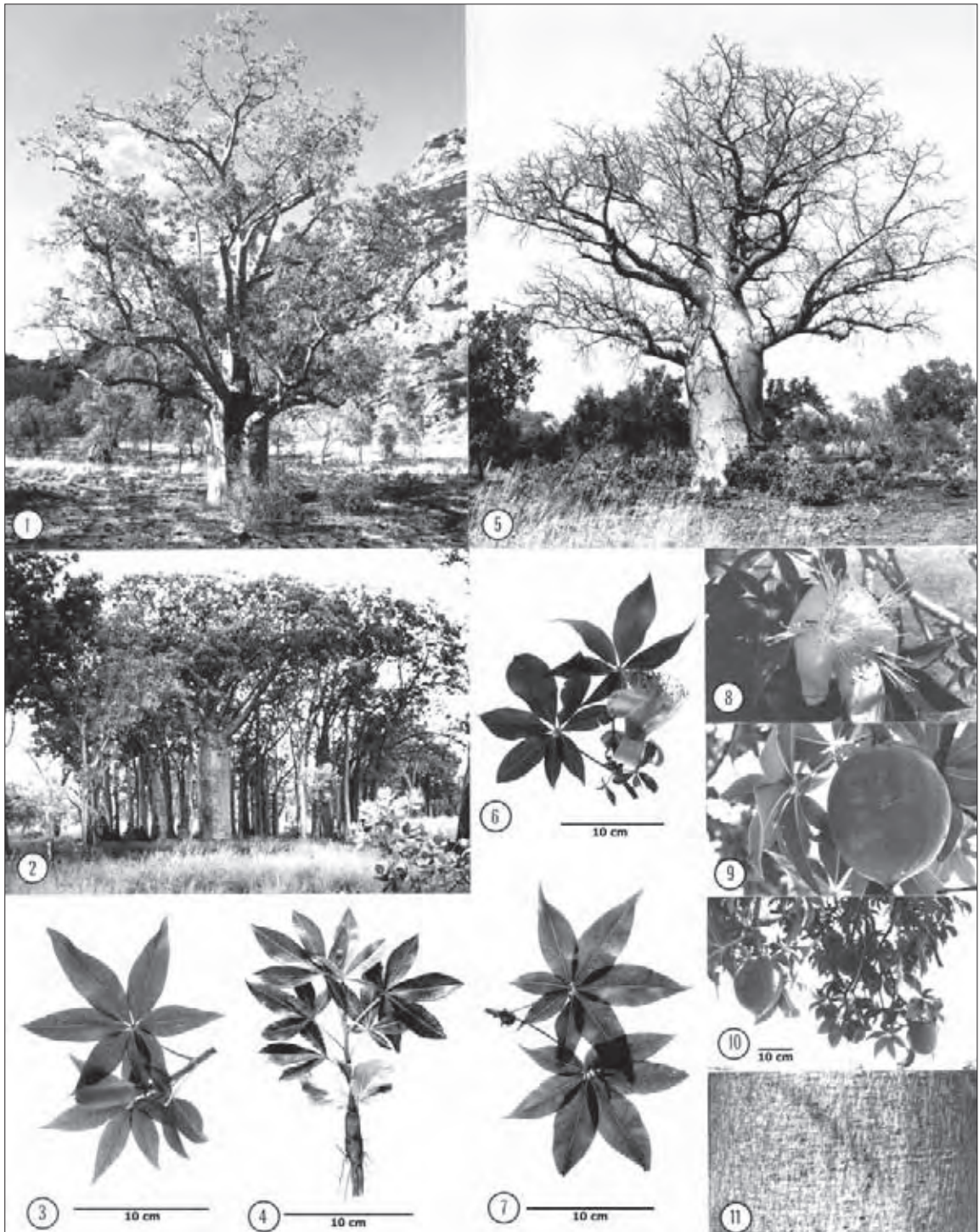
Inflorescences: Solitary, pedicellate 1.5–4.5 cm long; floral buds about 8 × 2 cm with 5 fused, brown-furry, sepals; apices of sepals free, triangular about 1 × 1 cm; petals imbricate. At flowering, sepals split and curl backwards towards base of flower in 4–5 segments. Flowers about 9 × 3 cm with oblanceolate, white, waxy, petals about 11 × 2 cm, which taper towards their bases to about 0.6 cm wide. The stamens are conspicuous, numerous (greater than 50), about 5–6 cm long and extend beyond the tops of the petals, bases fused into a relatively short small tube, about 2 × 0.7 cm, outside hairy. Ovary, 5- to 10-locular. Style longer than stamens, white, tipped with a spherical stigma that has small splits at the top. Flowers appear Nov.–Dec. and have a slight sweet smell.

Fruits: Pedicellate, the pedicels 10–20 cm long, twisted, spongy, brown-velvety, gourd-like, 15–25 × 10–20 cm, brownish to black. Seeds dark brown to black, bean-like, 1–1.5 × 0.5–1 cm enclosed in a powdery mass. Mature: Jan.–Apr.

Wood: Soft and porous, spongy, somewhat fibrous.

Climate: Altitudinal range: near sea level to 400 m; Hottest/coldest months: 35–39°C/13–18°C; Frost incidence: low; Rainfall: 500–1500 mm per year, summer max.

Distinctive features: A large deciduous tree with large swollen trunks, digitate leaves and pendulous velvety gourd-like fruit. Aboriginal people obtain water trapped in deep hollows inside large trees, or by chewing the roots. A white powder which fills the seed pods and surrounds the seeds can be made into a kind of bread or used to make a drink, or eaten dry.



Adansonia gregorii 1. Tree, near Kununurra, W.A. 2. Stand, near Kununurra, W.A. 3. Adult leaves and a floral bud 4. Seedling with cotyledons and thickened rootstock 5. Tree, Kimberleys, W.A. 6. Adult leaves and a flower 7. Adult leaves 8. Flower 9. Fruit 10. Fruits attached to tree 11. Bark

Cooktown Ironwood Ironwood

Erythrophleum chlorostachys (F. Muell.) Baill.

Cooktown ironwood is a medium-sized tree, often poorly formed and short-boled, attaining a height of 18 m and a diameter of 1 m. The stem is not buttressed. Some trees may be deciduous in the dry season. All parts of the plant are highly poisonous.

Cooktown ironwood has a wide distribution across northern Australia from north-eastern Queensland to the Kimberley area of Western Australia, with outliers in the Great Sandy Desert and a collection from the De Grey River in the Pilbara region; also on numerous off-shore islands throughout its range from the Kimberley to Torres Strait.

This tree grows on a wide variety of soil and rock types. It grows on rocky hillsides but probably reaches its best development on creek and river flats.

Cooktown ironwood is usually a component of the open forests and woodlands and because it occurs over such a large area it is associated with a large number of eucalypts.

Related species: There are no other species of *Erythrophleum* in Australia but the genus occurs in Africa and Asia.

Publication: *Hist. Pl.* 2, 150 (1870). Type: Burdekin River area, north-western Queensland, F. von Mueller.

Names: Botanical—*Erythrophleum*, Greek *erythros* (red), *phloios* (bark), probably in reference to the red colour of freshly cut bark; Greek *chloros* (green), *stachys* (spike), referring to the greenish inflorescence. Common—alludes to its very hard wood and its occurrence near Cooktown, Queensland.

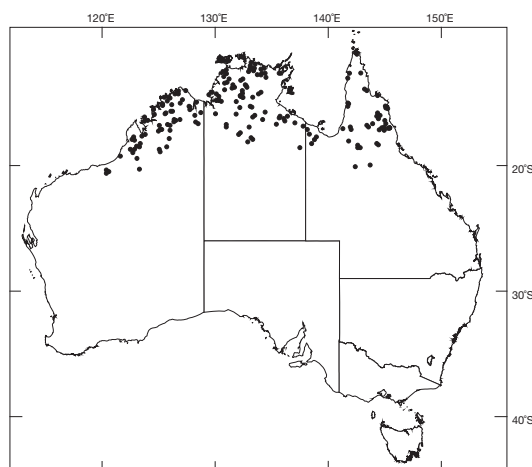
Bark: Hard, dark, rough and flaky or tessellated.

Leaves: Cotyledons—orbicular, about 1 × 0.8 cm. Seedling—alternate, paripinnate with two hair-like stipules about 0.2 cm long at the base of the hairy rhachis, about 3–5 opposite pairs of leaflets, entire, petiolules 0.1–0.2 cm long; leaflets, ovate-oblique, 1–2.5 × 0.5–1.5 cm, margins ciliate, midrib hairy, both surfaces with some scattered hairs on the leaf blades, green, discoloured, nervation not clearly visible on older leaflets but conspicuous on newer leaflets. Adult—spirally arranged, bipinnate, leaflets alternate, unequal-sided, obliquely orbicular to ovate, 3.5–5.3 × 2.5–5 cm, petiolules 0.2–0.4 cm long; lateral veins of leaflets in 6–11 pairs.

Inflorescences: Upper axillary spikes or panicles of spikes. Flower buds small and globular. Flowers sessile or subsessile, 5-merous, creamy green. Calyx lobes about 0.5–1 mm long, margins pubescent. Petals about 0.3 × 0.1 cm, margins pubescent. Stamens 10, filaments about 0.8 cm long. Ovary stalked, 1-celled, containing 4–8 ovules, style about 0.2 cm long, stigma small. Flowers are larger and distinctly pedicelate in the Broome–Dampier Downs area. Flowers Sept.–Dec.

Fruits: Flat legumes about 10–14 × 2.5–4 cm containing 1–8 flat seeds about 1 cm diameter.

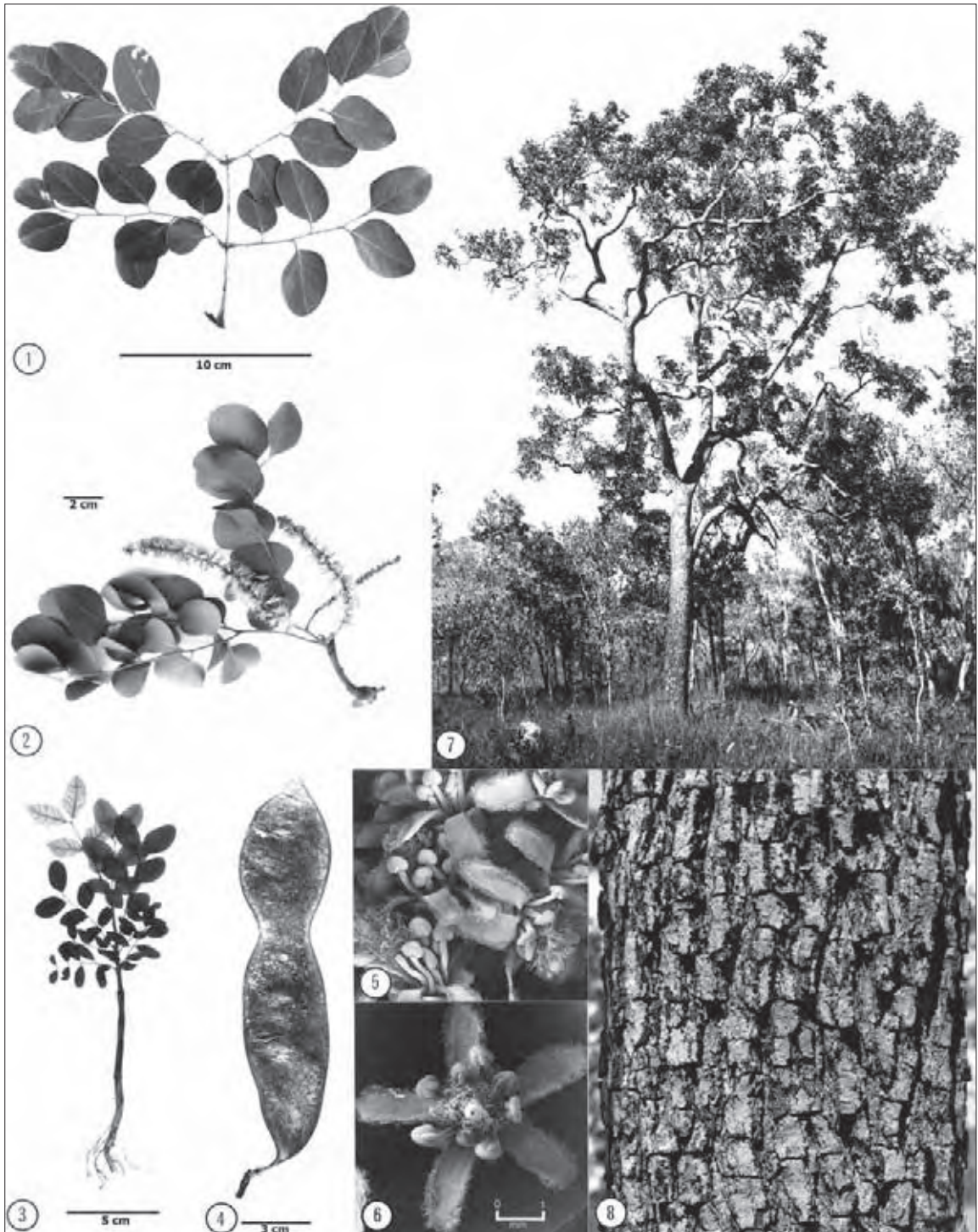
Wood: Sapwood susceptible to *Lyctus* attack; heartwood red, very hard, tough and strong, very durable when exposed to the weather and also in the ground. One of Australia's densest timbers with a density of 1180 kg m⁻³ and has low shrinkage similar to teak (*Tectona grandis*). Resistant to termite attack.



Very suitable for railway sleepers and similar needs where strength and durability are prime requisites.

Climate: Altitudinal range: 100–1000 m; Hottest/coldest month: 30–39°C/13–22°C; Frost incidence: low; Rainfall: 300–1700 mm per year, summer max.

Distinctive features: Dark rough bark, bipinnate leaves, creamy green flowers in spikes, flat legume, very hard and dense heartwood.



Erythrophleum chlorostachys 1. Adult leaves 2. Adult leaves and inflorescence 3. Seedling 4. Fruit 5. Flowers (S.E.M.) 6. Flower (S.E.M.) 7. Tree, near Atherton, Qld 8. Bark

Casuarinas

Casuarinas are very distinctive in the Australian landscape. They superficially resemble conifers with their wire-like foliage and woody fruiting structures. The name *Casuarina* is derived from the Malay *Kasuari* and alludes to similarity between the drooping foliage of the genus and that of the feathers of the cassowary bird. The foliage typically consists of jointed photosynthetic branchlets that have grooves running along their length in which the stomata are located. The ridges between the grooves terminate in small triangular teeth, or leaf tips, and collectively these form a whorl of minute leaves at the joint. The foliage is borne on persistent branches, the permanent branches of indeterminate length, and deciduous branchlets, the non-permanent branches of determinate length, which fall as entire units after 1–3 years of growth.

Casuarinas are represented in four genera. *Allocasuarina* is the largest genus and was segregated from *Casuarina* by Johnson (1982). *Allocasuarinas* are endemic to Australia and comprise 59 species that mainly occur in temperate parts of the continent. A centre of diversity is in the south-west of Western Australia where over 20 species are endemic. *Allocasuarinas* range in size from bushes a few centimetres high (e.g. *A. microstachya*) to tall forest trees some 20–30 m tall (e.g. *A. torulosa*). The genus *Casuarina* consists of 17 species that occur in South-East Asia, Malaysia, Melanesia, Polynesia, New Caledonia and Australia. Six species occur in Australia but none occur in Tasmania, in the extreme south-west of Western Australia or in central Australia. *Casuarina* species are usually arborescent trees associated with depositional landforms (e.g. *C. cunninghamiana* along riverbanks, *C. equisetifolia* along coastal dune systems, *C. cristata* on calcareous plains). The genus

Gymnostoma consists of 18 tropical species, occurring naturally from Malaysia to north-eastern Australia, Fiji and New Caledonia (Wilson and Johnson 1989). Only one species occurs in Australia, the rainforest endemic *Gymnostoma australianum*, which is restricted to the Thornton Peak area in north Queensland. A fourth genus *Ceuthostoma* comprises two species (*Ceuthostoma terminale* and *C. palawaensis*, occurring in northern Myanmar and Palawan), which mainly differ from *Gymnostoma* in having stomates in deep grooves (Johnson 1988). The four groups are the sole members of the family Casuarinaceae, which is the only family in the separate angiosperm order called Casuarinales. The most recent taxonomic treatment of all Australian casuarinas was by Wilson and Johnson (1989).

Species typically regenerate from seed but *C. glauca* and allies can spread clonally from root suckers and *C. equisetifolia* can be propagated from cuttings. Some species are able to regenerate rapidly after fire by producing shoots from thick woody rootstocks (e.g. *A. nana*) while others can coppice from concealed buds in the tree trunk (e.g. *A. torulosa*). The bark of most species is rather hard but some are corky (e.g. *A. torulosa*) and one (*A. inophloia*) has loose finely shredded bark. The photosynthetic branchlets in some species are long and weeping (e.g. *C. equisetifolia*) while in others they are upright and spiky as in *A. striata*. Many casuarinas occur early in the ecological succession of sites, are strongly light demanding and occupy a wide range of habitats. Sites range from skeletal soils on exposed cliffs (*A. nana*) to fringes of salt lakes (*C. obesa*). Many of the *Allocasuarina* species occur on sites of very poor fertility, e.g. *A. drummondiana* inhabits sandy, heathy sites in Western Australia. There is evidence that the ability of casuarinas to grow on

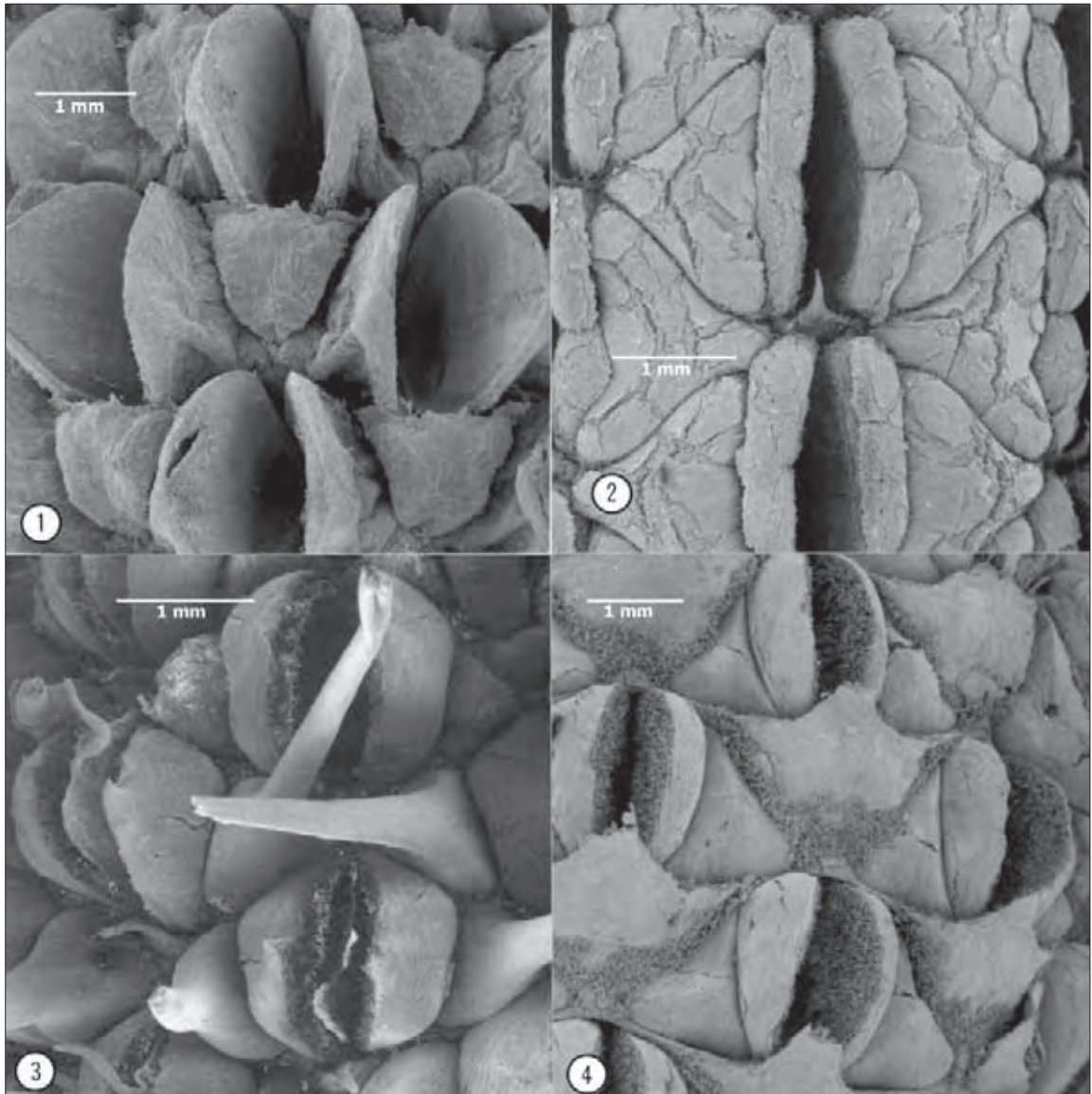


Figure 14 Casuarinas: (Ccu) *Casuarina cunninghamiana* (Ah) *Allocasuarina helmsii* (Aco) *Allocasuarina corniculatum* (As) *Allocasuarina striata*

Photographs of small sections of cones of each of four casuarina species, illustrating the kinds of variation that occur in bract and bracteole characters:

1. (Ccu) showing thin bracteoles with no easily discernible surface markings on their outer surfaces
2. (Ah) showing bracteoles with tessellations on their outer surfaces; such patterns are very distinctive in some species—the bracts here are relatively thin.
3. (Aco) showing long sharp spines that have developed as outgrowths on the back of the bracteoles; these spines are sharp and stiff making the ‘cones’ difficult to handle
4. (As) showing large and conspicuous trifold bracts; the bracteoles are woody and not prominently marked on their outer surfaces

poor sites is enhanced by their capacity to form symbiotic root nodules, which are capable of fixing atmospheric nitrogen. The nodules contain Actinomycete bacteria thought to belong to the genus *Frankia*. Casuarinas are the only non-leguminous angiosperms in Australia (with the possible exception of one species of *Discaria*), which are known to possess such nodules.

Casuarinas also have unusual floral features. The flowers are unisexual and the male and female inflorescences are quite different in appearance. Some species are monoecious but more are dioecious while some have both monoecious and dioecious 'races'. The male flowers appear in terminal or lateral spikes in whorls. The internodes between the whorls are short and at every node there is a cup-like structure consisting of laterally fused leaf teeth: these structures are homologous with the leaf teeth of the branchlets. At anthesis one stamen hangs out over each leaf. Each male flower consists of 1 anther and 1–2 perianth parts, which are often hooded over the top of the anther; there are 2 lateral bracteoles below each flower, and both the perianth parts and the bracteoles are closely appressed to the stamen before anthesis. The anthers vary in colour from dusty-brown, to red, to yellow depending upon the colour of the pollen. The pollen is disseminated by wind.

The female flowers terminate very short lateral shoots and are borne in dense, compact, ovoid or globular heads. There is a single flower in the axil of each bract. There are no perianth parts but there are two lateral bracteoles supported by a single bract enclosing a one-locular ovary. The long styles stand out beyond the bracts, facilitating wind pollination; after fertilisation the whole head becomes woody. This structure (the infructescence, i.e. the fruiting

inflorescence) is commonly called a cone and the woody bracteoles are known as valves. Each fruit (a samara) in the cone is very seed-like and is flattened and has a terminal wing, which is part of the pericarp; the remains of the style can be seen in the centre of the wing. When the fruits in the cone are ripe, the bracteoles retract and the fruits are released.

Most regional keys have used such characters as the colour and stiffness of the branchlets, the number of leaves at a joint, the shape and size of the 'cones', and the character of the bracteoles (valves) and the protuberances or markings on the back of the bracteoles. However, individual characters are often found to be variable within a species and thus make identification difficult, particularly in some *Allocasuarina* groups.

The wood of most casuarinas is dense and very hard. It makes an excellent fuel, used particularly in India and China, producing good heat and being relatively smokeless when burnt (*C. equisetifolia* is reputed to be the best fuelwood species in the world). The appearance of the wood, caused by dark-coloured, wide medullary rays, makes it attractive for woodturning and parquetry. The timber is also used for pulp in the Philippines and Okinawa. *C. equisetifolia* is widely grown as a windbreak in southern coastal China and also around citrus groves in Florida. The bark of *C. equisetifolia* has been used in tanning, in medicine and for the extraction of dyes. Several species are widely planted as street trees and in parks, for sand stabilisation after beach mining activities, and on mining spoil dumps; individual trees lend themselves for ornamental purposes such as topiary and hedges. The branchlets of some species (e.g. *C. cristata*, *A. stricta*) can be lopped and fed to stock during periods of drought.



Rock oak (*Allocasuarina huegeliana*) shown here at Sandford Rock, Western Australia, is a common tree species but is restricted to growing at base of granite rock outcrops that are scattered throughout the Western Australian wheat belt.



Pure stands of desert oaks (*Allocasuarina decaisneana*) are scattered throughout the red sandy deserts of central Australia. Their occurrence is thought to be controlled by access to ground water from fossil rivers deep below the sand.

Sheoak Western Sheoak

Allocasuarina fraseriana (Miq.) L.A.S. Johnson

Sheoak is typically a medium-sized tree up to 15 m tall and 0.5–1 m in diameter. Good specimens have straight boles for two-thirds of the tree height and small crowns. More commonly, however, the bole is only one-half or less of the total tree height with the crown being moderately large and containing large branches. The species is noted for the copious fall of branchlets throughout the year.

This species occurs in the south-western corner of Western Australia in the coastal and hinterland region from Perth in the north to near Albany in the east. There is a small isolated population between Moora and Jurien Bay. The species occurs typically on the coastal lowlands and in the Darling Ranges.

Sheoak occurs mainly on impoverished lateritic gravels, which may be deep or quite shallow with massive subsurface concretions. The species may also occur on heavily leached yellow siliceous sands along the coast. The topography is mostly one of rather gentle relief.

Sheoak usually occurs as an understorey to open forests of jarrah (*Eucalyptus marginata*) in the Darling Ranges where other associates include giant banksia (*B. grandis*), *Persoonia longifolia* and *Dryandra sessilis*. On sandy coastal soils the species occurs in woodlands or open forests in association with poor-formed jarrah (*Eucalyptus marginata*), and several banksias such as firewood banksia (*B. menziesii*), coast banksia (*B. attenuata*) and holly-leaved banksia (*B. ilicifolia*).

Related species: Not closely related to other casuarina species. Wilson and Johnson (1989) placed sheoak in its own section, *Amorophytis*.

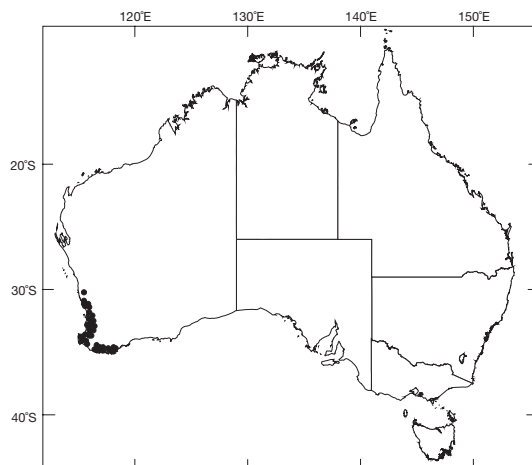
Publication: *J. Adelaide Bot. Gard.* 6, 75 (1982). Type: Near Perth, Western Australia, 1840, J.A.L. Preiss 2000.

Names: Botanical—honours C. Fraser (? 1788–1831), first superintendent of the Sydney Botanic Gardens and Colonial botanist. Common—sheoak is commonly applied to casuarinas and ‘she’ may refer to the sex of female trees or may be a corruption of the word for the sound made as wind blows the branchlets of a casuarina tree. However, it is most likely that the prefix ‘she’ means inferior, i.e. with oak-like timber but not as good as in true English Oak. The name ‘oak’ is explained under *Casuarina cunninghamiana*.

Bark: Outer surface is smoothish with a fine-textured surface, grey, soft and slightly flaky when rubbed. The newer bark beneath the older bark is light yellow and noticeably granular.

Leaves: Seedling—permanent and deciduous branches similar in morphology, whorls of 4–5 triangular leaf teeth, about 0.1–0.15 cm long, internodes (articles) 0.7–0.8 cm long, glabrous, dull-green. Adult—deciduous and permanent branches different in morphology; deciduous branches 16–32 cm long, shed after 2–3 seasons, thick (0.1 cm diameter), leaf teeth in whorls of 6–8, erect or spreading with ciliate margins, internodes (articles) 0.5–1 cm long, dull green.

Inflorescences: Male and female on separate trees. Male—on long cylindrical spikes, 5–10 × 0.3–0.5 cm, containing up to 50 whorls of male flowers per spike, at the end of deciduous



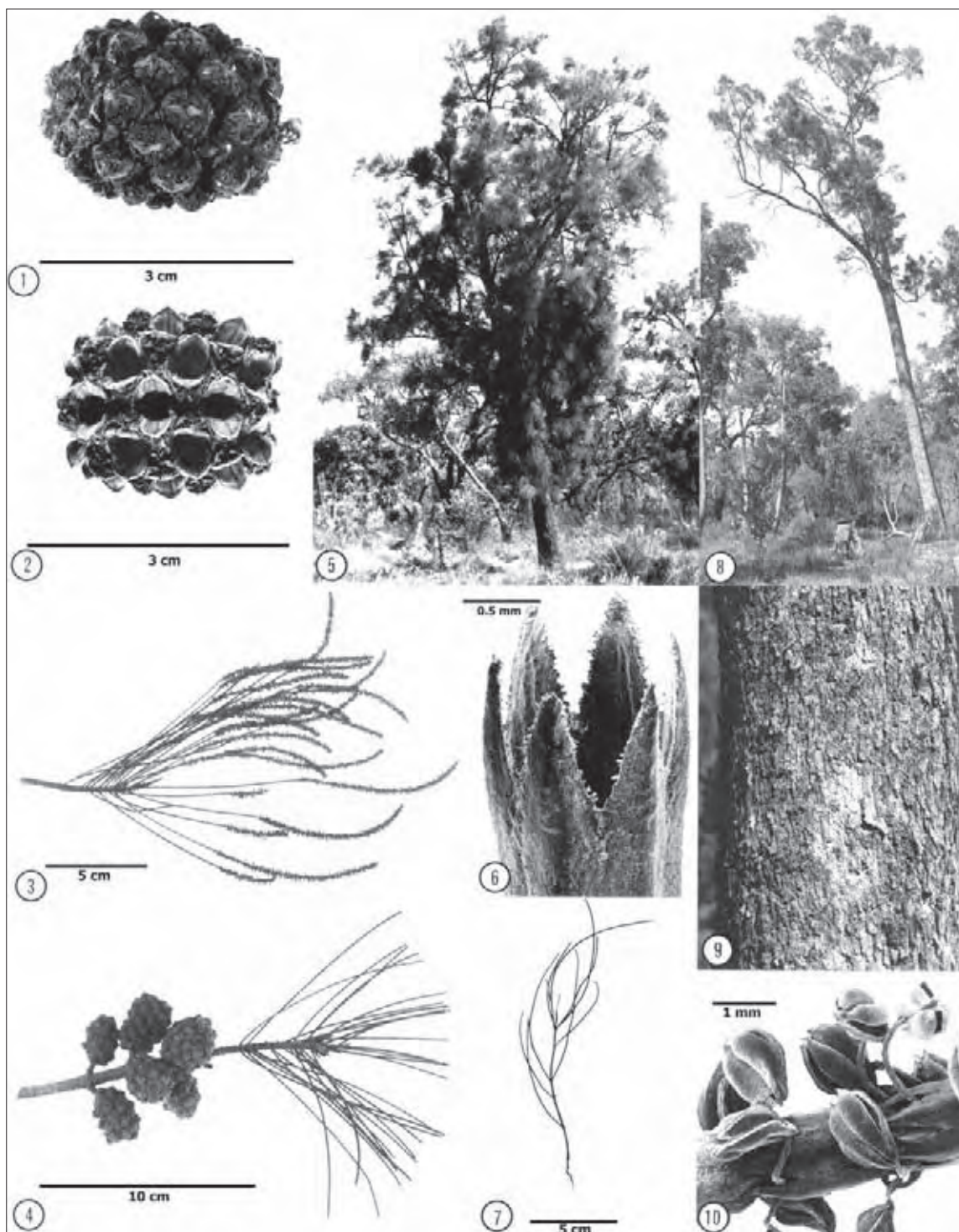
branches; male trees are golden brown when in flower in Jul.–Sept. Female—consisting of alternating whorls of 6–8, eventually forming a large subglobose to cylindrical cone, 2–4 × 2–3 cm, on a stalk 0.5–3 cm long, bracteoles very thick, shortly exserted, ferruginously pubescent, dorsal surface rugose with multiple protuberances, cone slits about 0.4 cm.

Fruits: Samaras, to 1 cm long, dark brown, with hyaline wing.

Wood: Sapwood pale; heartwood dark red, density 600–835 kg m⁻³. The wood is used for turnery, but was formerly used widely for roof shingles, barrel staves and fuel. This species is perhaps the only casuarina from Western Australia that has been utilised to any extent.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest month: 20–30°C/5–10°C; Frost incidence: low; Rainfall: 750–1000 mm per year, winter max.

Distinctive features: A tall casuarina, occurring frequently in association with jarrah (*E. marginata*) and bull banksia (*Banksia grandis*). The fruits are large, woody and often appear misshapen. The backs of bracteoles of the cone are covered with tessellations and a mass of fine hairs. Slender brown hairs are found in the cavities formed after the bracteoles have released the fruit.



Allocasuarina fraseriana 1. Cone before dehiscence 2. 'Cone' after dehiscence 3. Male inflorescences at ends of deciduous branchlets 4. Fruiting branch 5. Tree between Kelmscott and Roleystone, W.A. 6. Leaf teeth at joint (S.E.M.) 7. Seedling 8. Tree between Kelmscott and Roleystone, W.A. 9. Bark 10. Male flowers showing anthers (S.E.M.)

Forest Oak Rose Sheoak

Allocasuarina torulosa (Aiton) L.A.S. Johnson

Forest oak is a medium-sized to tall tree attaining 12–30 m in height and 0.3–1.3 m in diameter. It is usually an understorey species. The bole is half or more of the tree height and the main branches are spreading to erect. The foliage is clumped at the ends of branches and is usually pendent, giving the crown an open appearance. The bases of the deciduous branches have a distinctive copper-coloured appearance at certain times of the year.

This species is found in eastern Australia from the McIlwraith Range on Cape York Peninsula and east of Coen (on Mt Carter) in northern Queensland, to south of Nowra, in south coastal New South Wales. It occurs throughout the northern and central coastal and coast range regions of New South Wales, but only to a limited extent in the south, while in Queensland it is found in coastal areas and on the slopes of the Great Dividing Range. It also occurs on Fraser Island, the Blackdown Tableland and the Eungella Range.

It occurs mainly on undulating to hilly topography and grows over a wide range of soils, such as those derived from sandstones, shales, basalts and granites; but it usually does not occur on the most highly deficient and sandy soils.

Forest oak is typically an understorey species in open or tall open forests. In good-quality stands associated tree species include blackbutt (*Eucalyptus pilularis*), Sydney blue gum (*E. saligna*), tallowwood (*E. microcorys*), turpentine (*Syncarpia glomulifera*) or brush box (*Lophostemon confertus*). When the site is suitable it may be the main understorey species but, on areas tending to rainforest, competition from other species may limit its occurrence. On somewhat drier sites it may be associated with such eucalypts as white mahogany (*E. acmenoides*), grey ironbark (*E. paniculata*) and grey gums (*E. punctata* or *E. propinqua*).

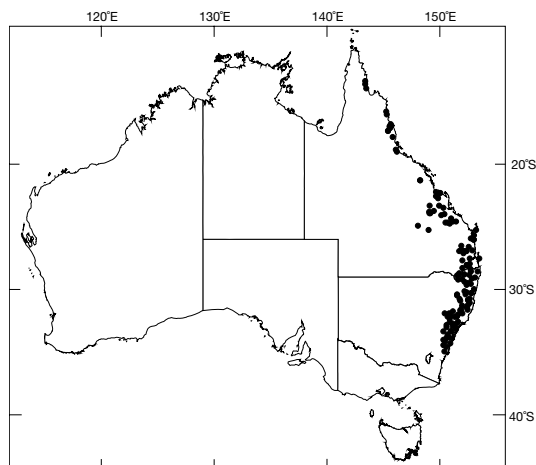
Related species: The most closely related species is karri oak (*A. decussata*), which is a medium-sized understorey tree in the karri (*Eucalyptus diversicolor*) forests of Western Australia.

Publication: *J. Adelaide Bot. Gard.* 6, 79 (1982). Type: Bay of Inlets, Queensland, 1770, J. Banks and D. Solander.

Names: Botanical—Latin *torulus* (a little bulge, protuberance), *osus* (abounding in), in reference to the warts on the backs of the bracteoles in the cone. Common—oak is explained under notes for *C. cunninghamiana*.

Bark: Persistent over the whole of the trunk and branches, light brown to black, vertically and transversely fissured, leaving short sharp ridges of cork.

Leaves: Cotyledons—sessile, elliptical, about 0.6–0.7 × 0.3–0.4 cm. Seedling—whorls of 4 closely appressed triangular scale-leaves at joints, internodes (articles) about 0.5–0.6 cm; seedlings have pronounced tuber-like swellings just below ground level which contain large quantities of starch. Adult—deciduous and permanent branches approximately similar in



morphology; deciduous branchlets are more or less pendent, dark green, densely arranged, soft, short (about 5–8 cm long), circular or angular in cross-section; thin (about 0.02 cm diameter), leaf teeth in whorls of 4 to 5; internodes short (about 0.3–0.6 cm long); bases of branchlets often copper-coloured with tips of branchlets usually green.

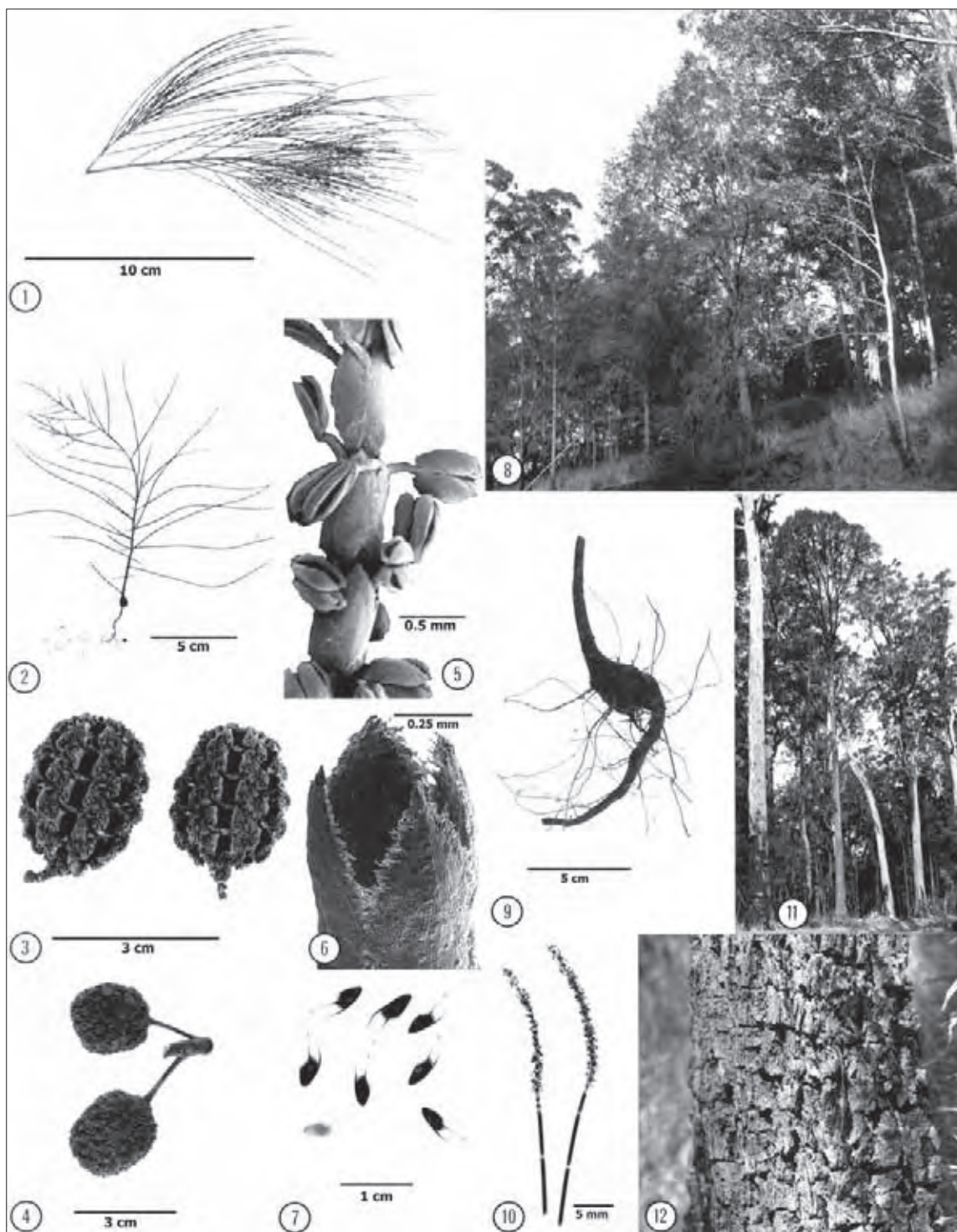
Inflorescences: Male and female on separate trees. Male—grouped in whorls of 4 rarely 5, forming short cylindrical spikes about 1.3–3 cm long at the ends of deciduous branchlets. Female—grouped in alternating whorls of usually 5 rarely 6, eventually forming a 'cone', 2–3 × 2–2.5 cm, on a slender stalk about 1–3 cm long. Bracteoles are thick and woody and covered by numerous warty protuberances; the backs of contiguous bracteoles are closely appressed, giving a solid woody mass with short longitudinal slits about 0.5 cm long.

Fruit: Lustrous brown samaras, each 0.4–0.6 × 0.2–0.3 cm, with a transparent terminal wing.

Wood: Sapwood is pale, not attacked by *Lyctus*; heartwood is dark with very wide rays, which are even darker coloured, strong, hard, fissile, very dense, density 720–1130 kg m⁻³. Wood can be sliced for veneer and used for fancy turnery and small cabinetwork. It is an excellent fuel.

Climate: Altitudinal range: sea level to 1000 m; Hottest/coldest month: 25–30°C/0–15°C; Frost incidence: low to moderate; Rainfall: 1000–2000 mm per year mainly summer max.

Distinctive features: Forest oak has 4, rarely 5, teeth per leaf whorl (except on female inflorescence shoots); rather large, warty, often pendent fruiting cones; pendent male tassels and compact short branchlets that are often green-tipped but copper-coloured at their bases; and corky light brown bark.



Allocasuarina torulosa 1. Adult branchlets 2. Seedling 3. 'Cones' after dehiscence 4. Cones before dehiscence 5. Male flowers (S.E.M.) 6. Leaf teeth at joint (S.E.M.) 7. Seeds (samaras) 8. Stand, Dorriggo Mtn, near Dorriggo, N.S.W. 9. Tuber on seedling 10. Male inflorescences 11. Tree, Washpool State Forest, near Grafton, N.S.W. 12. Bark

Belah and Black Oak

Casuarina cristata Miq. and *C. pauper* F. Muell. ex. L.A.S. Johnson

Belah is typically a medium-sized tree up to 20 m tall and 1 m in diameter, while black oak, which occurs in the drier, inland areas, is decidedly more stunted and only 5–15 m tall and up to 0.5 m in diameter. The foliage of belah tends to be drooping while it is held somewhat erect in black oak. The species can regenerate by root suckering.

These are widespread species. Belah occurs in a belt from well north of Rockhampton and Emerald, Queensland, to near Griffith in southern New South Wales over the lower slopes and plains west of the Great Dividing Range. Black oak occurs mainly on the plains west of Cobar, Hillston and Balranald, New South Wales, and in north-western Victoria, across southern central South Australia (Flinders Ranges, upper Eyre Peninsula and Maralinga areas) into the central southern parts (Kalgoorlie, Meekathara and the western edge of the Great Victoria desert) of Western Australia. There is also a small extension into far south-western Queensland.

Belah commonly occurs on self-mulching heavy black or grey soils that are more or less alkaline. Common habitats are flats and depressions where it forms dense stands. Black oak more commonly occurs on lighter textured soils than belah such as red-brown sands and sandy loams commonly with calcium carbonate concretions in the lower horizons.

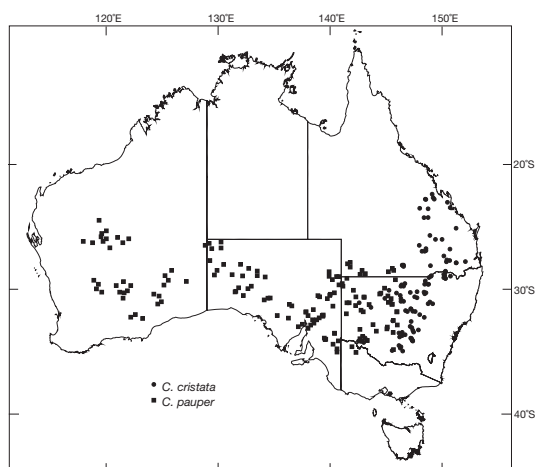
Belah occurs in woodlands or open forests and common associates include whitewood (*Atalaya hemiglauc*) and inland rosewood (*Heterodendrum oleifolium*). Black oak occurs in low open woodlands or tall shrublands and common associates are inland rosewood (*Heterodendrum oleifolium*) in New South Wales and mulga (*Acacia aneura*) in New South Wales and South Australia and several eucalypts such as gimlet (*E. salubris*) and salmon gum (*E. salmonophloia*) in Western Australia. It commonly occurs with numerous shrubs such as *Myoporum platycarpum*, *Pittosporum phillyreoides* and *Geijera parvifolia*.

Related species: Black oak differs from belah in the usually thicker and more waxy-surfaced branchlets and the shorter fruiting bracteoles (valves) of the cone. The trees are typically smaller and of poorer form. There are intermediates where the two species meet in western New South Wales. Their closest relatives are probably the swamp oaks, *C. glauca* and *C. obesa*.

Publication: *C. cristata*: Rev. Crit. *Casuar.* 70, t. 10 (1848). Type: At 'Fields Plains', Condobolin district, New South Wales, A. Cunningham. *C. pauper*: Fl. Austral. 3, 201. Type: Flinders Ranges, South Australia, Oct. 1852, F. von Mueller.

Names: Botanical—Latin *cristatus* (crested), perhaps alluding to the long pointed bracteoles of the cones; Latin *pauper* (poor, scanty, meagre) perhaps alluding to the smaller, poorer habit of this species compared to belah. Common—belah is of Aboriginal origin.

Bark: Hard, dark brown to blackish with a tight scaly appearance.



Leaves: Cotyledons—sessile to slightly conjoined at base, elliptical; to 0.5 × 0.25 cm; hypocotyl reddish and minutely hairy. Seedling—deciduous and persistent branches similar in morphology, whorls of 4 leaf teeth closely appressed to the branch at the joint, gradually increasing in number, internodes (articles) 0.3–0.4 cm long. Adult—deciduous and permanent branches noticeably different in morphology, deciduous branches robust, dark olive-green to grey, mostly pendent branchlets 10–20 cm long, shed after 2–3 seasons, leaf teeth in whorls of 9–16, internodes (articles) about 0.7–1.5 cm long, teeth erect, appressed, articles 0.6–0.9 mm diameter, occasionally sparsely pubescent (*cristata*) or teeth spreading to recurved, articles 1–1.8 mm diameter, densely pubescent (*pauper*).

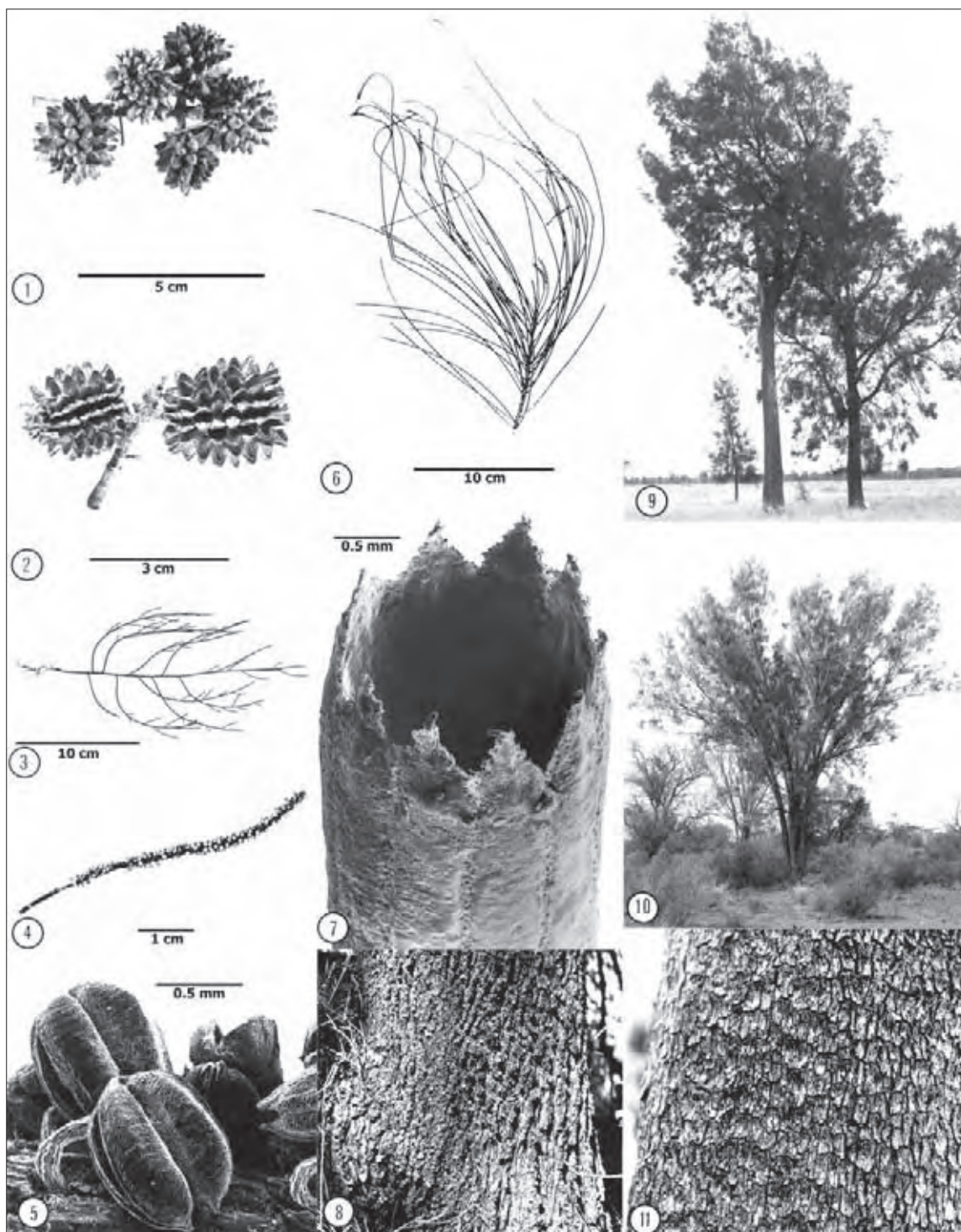
Inflorescences: Male and female on separate trees. Male—flowers on small slender terminal spikes at the end of deciduous branches. Female—grouped in alternating whorls of 9–16 flowers, eventually forming a cone which is grey, subspherical to rounded oblong in shape, 1.5–3 × 1.5–2.5 cm nearly sessile on stalks 0.1–0.3 cm long, bracteoles relatively thin, triangular, protruding, 0.3–0.4 × 0.3–0.4 cm (*cristata*) or shorter and tawny-pubescent (*pauper*) and opening widely at dehiscence; backs of individual bracteoles can have long striations running down from the apex.

Fruits: Samaras, dull yellow-brown, elliptical, flattened, up to 0.6 × 0.2 cm, papery transparent wing with conspicuous midrib.

Wood: Sapwood is wide and creamy coloured, *Lyctus* susceptibility unknown; heartwood is reddish brown, fissile, very dense, density 1100 kg m⁻³. The wood is used for fencing and makes good fuel; poles are used for building stockyards. The wood is excellent for turnery.

Climate: Altitudinal range: 400–500 m; Hottest/coldest month: 30–35°C/1–5°C (*cristata*), 32–36°C/3–7°C (*pauper*); Frost incidence: moderate; Rainfall: 450–650 mm per year (*cristata*), 200–350 mm per year (*pauper*) mm per year, mainly summer max. (*cristata*), mainly winter max. (*pauper*).

Distinctive features: Arborescent casuarinas with hard bark and fruits with pointed bracteoles protruding from the cone.



Casuarina cristata 1. Cones before dehiscence 2. Cones after dehiscence 3. Seedling 4. Male inflorescence 5. Male flower showing anther (S.E.M.) 6. Adult branchlets with male inflorescences at ends 7. Leaf teeth at joint (S.E.M.) 8. Bark 9. Trees of *C. cristata* between Naromine and Nyngan, N.S.W. 10. Trees of *C. pauper* between Kalgoorlie and Coolgardie, W.A. 11. Bark

River Oak River Sheoak, Creek Oak (Qld)

Casuarina cunninghamiana Miq.

River oak is usually a medium-sized to tall tree attaining 20–35 m in height and 0.5–1.5 m in diameter. It is the largest species of the genus in Australia, although in open country in the north of the area of occurrence, such as south-east of the Gulf of Carpentaria in Queensland and in the Northern Territory, it may be only 12 m in height and straggly in appearance. There are two subspecies, the typical and subsp. *miodon*.

Subsp. *cunninghamiana* occurs in narrow belts along permanent freshwater watercourses throughout eastern Australia from Bega, southern New South Wales to the Laura basin in northern Queensland. It extends inland to east of Chillagoe and Augathella in Queensland and to Condobolin and west of Narrandera in New South Wales. Subsp. *miodon* grows along fresh or brackish permanent streams and extends east from the Daly River, Northern Territory to the Gulf of Carpentaria, Queensland.

River oak mainly grows as pure stands on river and stream banks in open forests, especially in the belt between normal water level and maximum flood level, and occasionally on adjacent river flats. The species may extend for a short distance up rocky hillsides, chiefly on limestone. The soils range from fine-textured sands through to gravels in terraces of old river courses. In the typical riverine location the roots have access to flowing water or seepage.

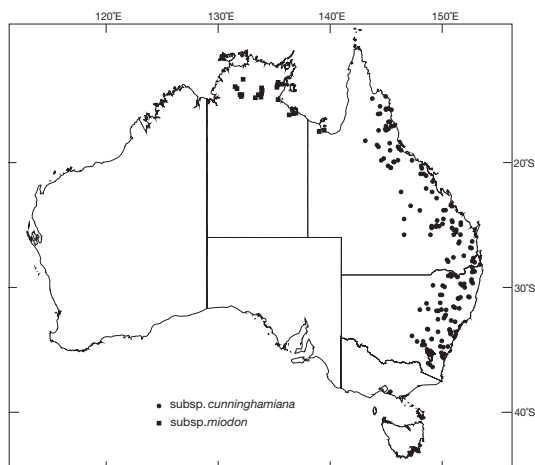
The tree is used for ornamental planting, for shade and shelter and shows an ability to grow satisfactorily on comparatively dry soils. The foliage, particularly of seedlings, is a usable drought fodder.

Related species: Of the species occurring in eastern Australia river oak is closely related to *C. glauca*. It differs from this species in its preference for sites where the groundwater is fresh rather than salt or brackish, its fewer teeth per whorl (8–10 versus 12–16) and its shorter, thinner branchlets. Occasional intermediate forms, considered to be hybrids, occur where the habitats of the two species meet, e.g. near Wisemans Ferry, New South Wales.

Publication: Subsp. *cunninghamiana*: *Rev. Crit. Casuar.* 56, t. 6A (1848). Type: Sandy shores of Moreton Bay and Glasshouse Bay, Queensland, collector unknown. Subsp. *miodon*: *Fl. Austral.* 3, 200 (1989). Type: 23 km NNE of Borroloolua on Bing Bong road, Northern Territory, 13 May 1983, K.L. Wilson 5361.

Names: Botanical—after A. Cunningham (1791–1839), an explorer and botanical collector mainly in eastern Australia. Common—alludes to the habitat on river banks, and the conspicuous medullary rays which reminded the early settlers of true oaks (*Quercus* spp.).

Bark: Persistent over the whole of the trunk and branches, dark grey, hard, deeply furrowed longitudinally and irregularly in a transverse direction. On young trees the numerous raised white, horizontally disposed, lenticel-like pustules are conspicuous.



Leaves: Seedling—deciduous and permanent branches similar in morphology, whorls of 6–8 acute leaf teeth close to the cotyledons, internodes (articles) 0.1–0.4 cm long and branches noticeably ridged. Adult—deciduous and permanent branches noticeably different in morphology, deciduous branches, soft, short (10–25 cm long), shed after 2–3 seasons, thin (about 0.05 cm diameter), leaf teeth in whorls of 8–10 (*cunninghamiana*) or 6–7 (*miodon*), yellow at base, darker brown towards apex and marcescent (*cunninghamiana*) or uniformly yellow, not marcescent (*miodon*); phyllichnia prominently angular (*cunninghamiana*) or phyllichnia angular to nearly flat (*miodon*); internodes (articles) short (0.5–0.8 cm long).

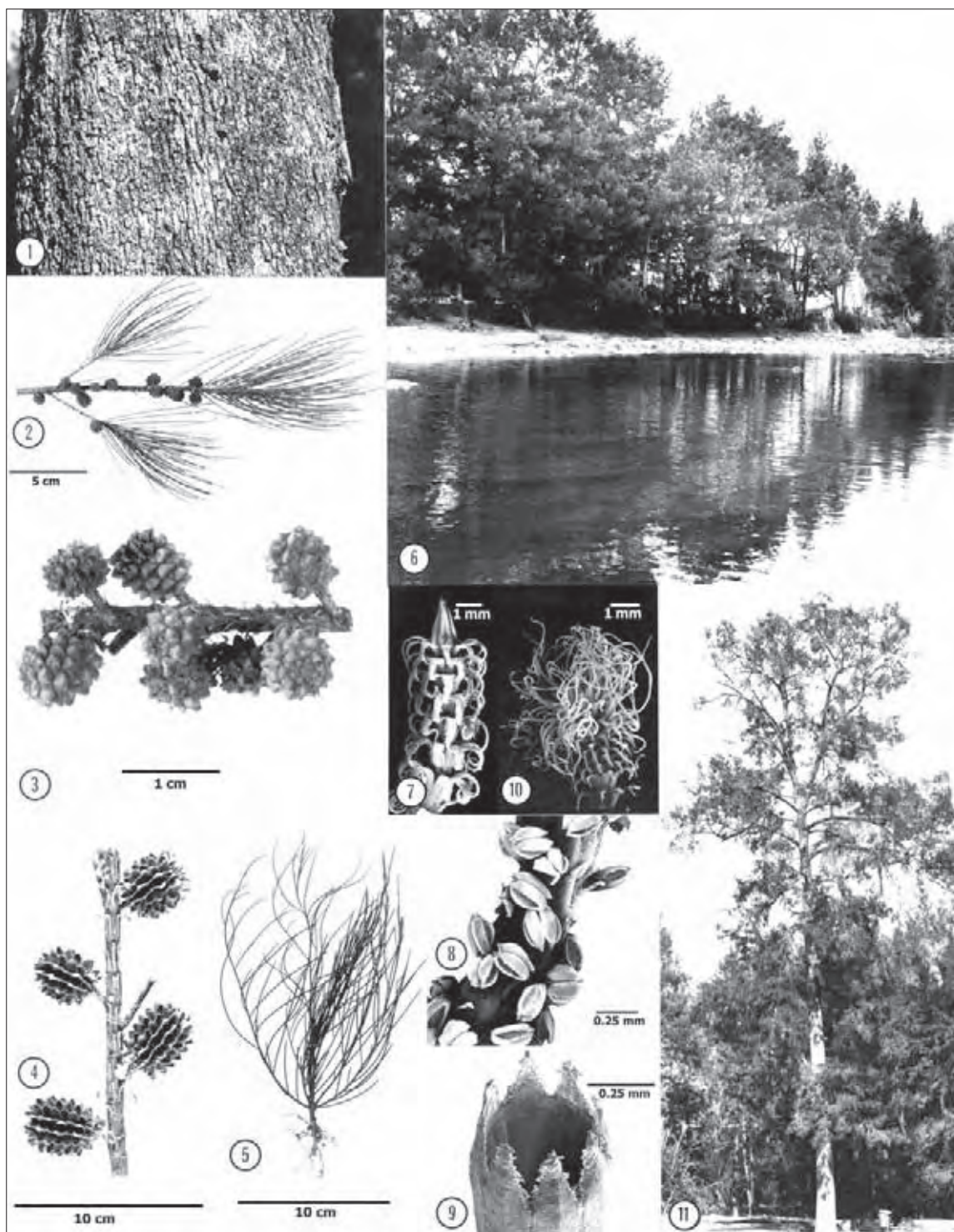
Inflorescences: Male and female on separate trees. Male—grouped in whorls forming short cylindrical spikes 3–4 cm long, at the end of deciduous branchlets. Female—grouped in about 6–7 alternating whorls of 6–8 flowers to eventually form a subglobose cone, about 0.8–1 × 0.8–1 cm, on a stalk about 0.3–0.8 cm long, often among the foliage; cone bracteoles broadly acute (*cunninghamiana*) or sharply acute (*miodon*), bracteoles relatively thin and dehisce rapidly when mature. Flowers Feb.–Mar.

Fruits: Pale brown samaras, ovate, each about 0.2 × 0.1 cm, slightly flattened with a short, barely transparent terminal wing having a prominent middle vein, enclosed by the woody bracteoles of the cone.

Wood: Sapwood is narrow, whitish, not susceptible to *Lyctus* attack; heartwood is dark reddish or purplish brown, fissile, close-grained except for the medullary rays, moderately strong and very tough when seasoned, comparatively durable for a casuarina, density 710 kg m⁻³. In the past the timber was used for heads of casks, axe handles, ornamental turnery, shingles and bullock yokes. It is an excellent fuelwood.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest month: 25–40°C/0–15°C; Frost incidence: low to high (at inland and upland sites); Rainfall: 500–1500 mm per year, uniform to summer max.

Distinctive features: A tall casuarina with soft foliage and small cones that occurs along the banks of permanent freshwater streams.



Casuarina cunninghamiana 1. Bark 2. Fruiting branch 3. Cones before dehiscence 4. Cones after dehiscence 5. Seedling 6. Stand, Murrumbidgee River, near Canberra, A.C.T. 7. Apex of a growing shoot showing recurved leaf teeth (S.E.M.) 8. Male flowers showing anthers (S.E.M.) 9. Leaf teeth at joint (S.E.M.) 10. Female flowers showing the long styles (S.E.M.) 11. Tree, Uriarra Crossing near Canberra, A.C.T.

Coast Sheoak Beach Sheoak, Horsetail Sheoak, Beach Casuarina, Whistling Tree

Casuarina equisetifolia L.

In Australia coast sheoak is usually a small to medium-sized tree 8–16 m tall with a dbh rarely greater than 50 cm. Its form can be very variable ranging from low branching, spreading trees on exposed sites to taller erect trees in more sheltered sites. The crowns have fine branching and pendulous foliage. There are two subspecies, the typical and subsp. *incana*.

Subsp. *equisetifolia* extends along coastal north-eastern Australia from Darwin and Tiwi Islands in Northern Territory east to the Cairns region in northern Queensland. It also occurs in Malaysia, Thailand, Myanmar, Vietnam, Melanesia and Polynesia. Subsp. *incana* is the southern form of this species extending south from Rockhampton in Queensland to Camden Head north of Taree in New South Wales. Populations in the Cooktown to Mackay region represent intergrades between the two subspecies. Subsp. *incana* also occurs in New Caledonia and Vanuatu.

Coast sheoak occurs along coastal landforms in close proximity to the sea. It is most commonly found along beach foredune systems but it also occurs near estuaries or sometimes on rocky headlands (*incana*). Soils comprise mainly calcareous sands with sandy loam at depth, derived from tidal and aeolian deposition.

This species usually occurs in pure stands, as few other woody species can tolerate the difficult growing conditions experienced along coastal foreshores.

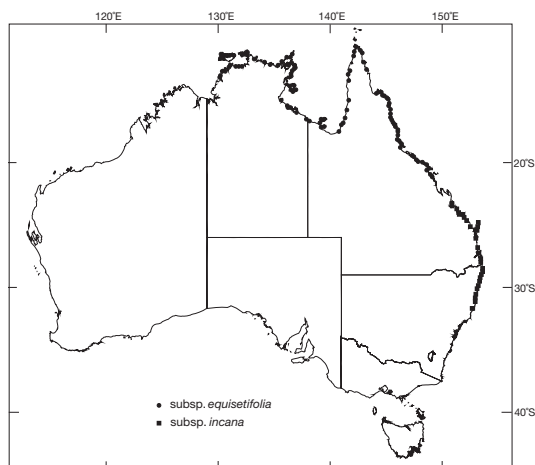
Related species: Coast sheoak is not considered to have particularly close affinities to other species; phyllichnia have 7–8 leaf teeth per node and its flowers are monoecious.

Publication: Subsp. *equisetifolia*: Amoen. Acad. 143 (1759). Type: Rumphius, *Herbarium Amboinense* 3, t. 57. Subsp. *incana* (Benth.) L.A.S. Johnson: *J. Adelaide Bot. Gard.* 6, 79 (1982). Type: Port Macquarie, New South Wales, May 1819, A. Cunningham 45.

Names: Botanical—Latin *equinus* (pertaining to horses), Latin *folium* (a leaf) alluding to the similarity of the cladodes to horse hair, Latin *incanus* (hoary or white) in reference to the hairy new shoots. Common—alludes to the habitat of the species occurring along coasts, and the conspicuous medullary rays which reminded the early settlers of the same feature in the true oaks (*Quercus* spp.) of the northern hemisphere.

Bark: Persistent over the whole of the trunk and branches, grey to light grey-brown, smooth on maturing trees, hard, scaly or furrowed on older trees. Young trees have numerous bands of lenticels.

Leaves: Seedling—whorls of 7–8 acute leaf teeth close to the cotyledons, articles (internodes) and branches noticeably ridged. Adult—branchlets pendulous, needle-like, finely longitudinally furrowed, 23–38 × 0.1 cm; phyllichnia prominently angular, glabrous or glabrescent (*equisetifolia*) or prominently angular to flat (in older growth often on same branchlet), usually densely hairy, particularly when immature (*incana*), (6–)7–8 leaf teeth per node, 0.3–0.8 mm long; articles (internodes) 0.5–0.7 mm in diameter (*equisetifolia*) or 0.7–1 mm in diameter (*incana*).



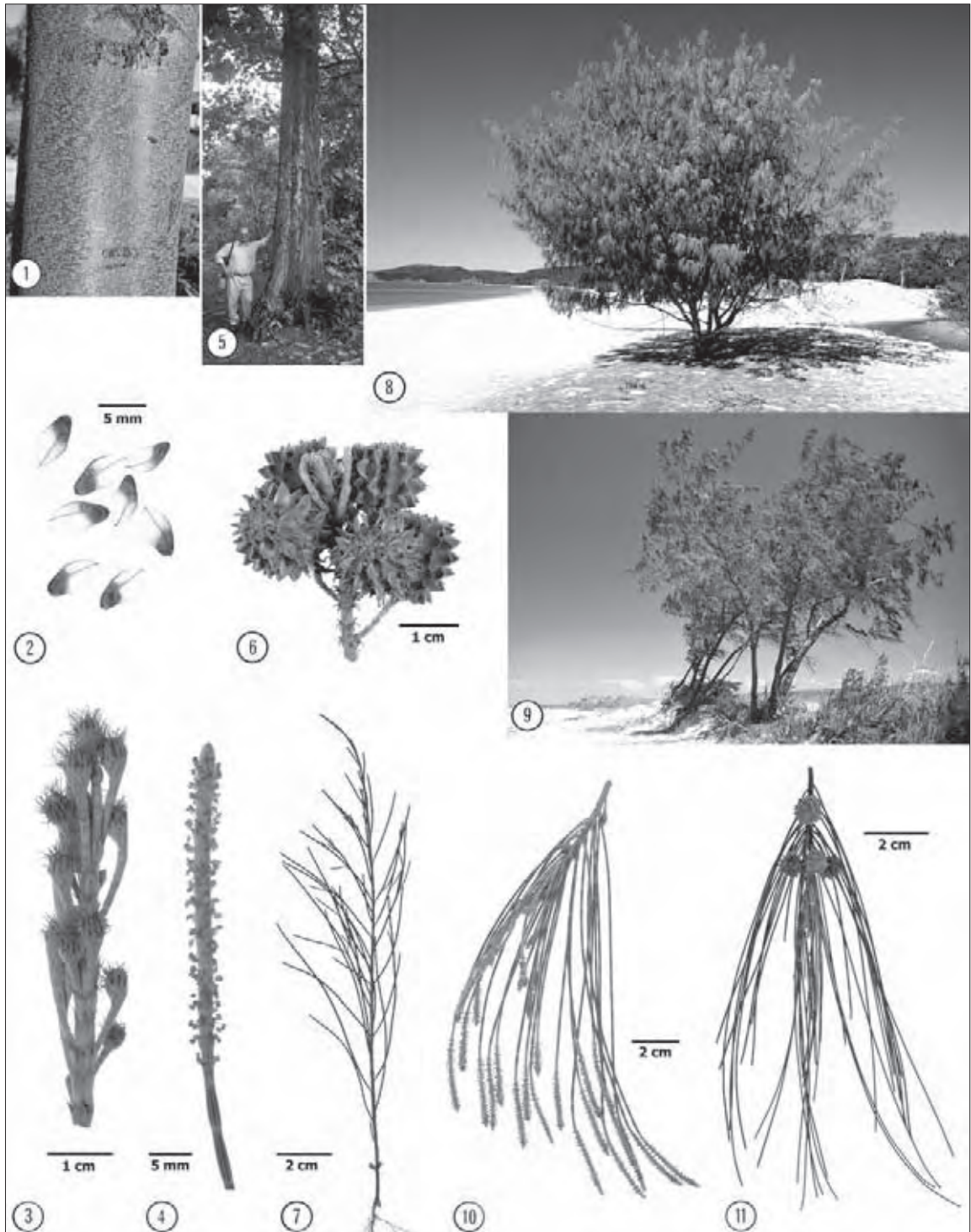
Inflorescences: Male and female on the same plant (monoecious). Male—grouped in simple, terminal whorls forming short cylindrical spikes 0.7–4 cm long. Female—borne on lateral woody branches, forming a globose cone, 1–2.4 × 0.9–1.3 cm, on a short stalk, 0.1–1.3 cm long, often among the foliage; cone bracteoles acute, more or less protruding from the surface of the cone; sparsely hairy (*equisetifolia*) or covered in fine, white or rusty hairs (*incana*). Flowers Aug.–Sept. (*equisetifolia*), Sept.–Oct. (*incana*).

Fruits: Dull brown samaras, ovate, 0.6–0.8 cm long, slightly flattened with a short, barely transparent terminal wing having a prominent middle vein, enclosed by the woody bracteoles of the cone. Mature Nov.–Feb. (*equisetifolia*), Mar.–Apr. (*incana*).

Wood: Sapwood is not susceptible to *Lyctus* attack; heartwood is very hard and very heavy, lacks the prominent rays characteristic of other casuarinas, density 960 kg m⁻³, strong and durable in the ground or submerged in saltwater; an excellent firewood burning satisfactorily when green and produces an exceptionally fine charcoal. Uses throughout its range include fishing boat masts, piles, posts, roof shingles, tool handles and paper pulp (cultivated stands).

Climate: Altitudinal range: near sea level to 100 m; Hottest/coldest month: 30–35°C/6–20°C; Frost incidence: nil to low; Rainfall: 950–2100 mm per year, summer max.

Distinctive features: A casuarina occurring along coastal foreshores, normally in pure stands, with a crown that comprises drooping, needle-like foliage; male and female flowers are monoecious; fruits are woody cones that have rows of numerous bracteoles; phyllichnia have 7–8 leaf teeth per node. This species is planted in many countries for many purposes including shelterbelts and land rehabilitation of sandy sites.



Casuarina equisetifolia 1. Bark on maturing tree 2. Seeds 3. Female flowers 4. Male flowers 5. Bark on mature tree 6. Dehiscent cones 7. Seedling 8. Tree, Percy Island, Qld (subsp. *incana*) 9. Tree, Wah Wee Beach, N.T. (subsp. *equisetifolia*) 10. Flowering sprig 11. Sprig with mature cones

Swamp Oak Swamp Sheoak

Casuarina glauca Sieber ex Sprengel

Swamp oak is usually a medium-sized tree up to 20 m tall and with stem diameters to 0.75 m, with older trees being slightly buttressed at their bases and the trunks occasionally fluted. The species is very conspicuous in coastal situations and is often found just behind the mangrove fringe. Crowns and stems are often slender where the species grows in dense, pure stands. It typically has a poorly developed taproot and a well-developed lateral root system. The foliage is greyish, has long pendulous stiff branchlets, which are noticeably of uneven length. The species is able to sucker vigorously from its roots.

This species occurs near the sea between Bermagui in south coastal New South Wales through to north of Gladstone, Queensland, with an insular occurrence on Fraser Island. In only two regions does it extend far inland, and these are in the Sydney region (about 50 km inland) and the Singleton area (about 80 km inland).

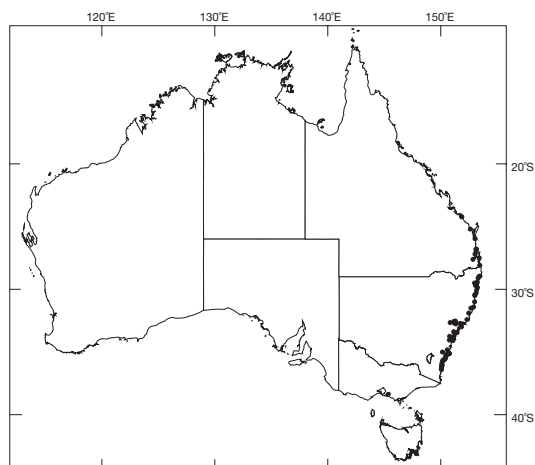
Swamp oak occurs on flat, swampy sites or in close proximity to salty or brackish water. The species grows on river banks and beside streams affected by tidal influence and commonly forms belts 5–50 m wide. Swamp oak occurs on dark, alluvial soils that have a high organic content. The soils are usually fairly acidic but saline and with various mineral nutrients in good supply. The water table is usually within 1 m of the surface.

The species typically forms pure stands in open forests and woodlands and, while it usually grows on drier ground fringing grey mangrove (*Avicennia marina*) and *Melaleuca* species (chiefly *M. quinquenervia*) swamps, it may on occasion be found growing in admixture with the latter. Other species found nearby include forest red gum (*Eucalyptus tereticornis*) and occasionally species of the littoral rainforest such as red ash (*Alphitonia excelsa*) and tuckeroo (*Cupaniopsis anacardioides*). Some unusual stands are the small shrub-like communities, that are often burnt, on exposed coastal headlands, and in these situations common associates include coast bank-sia (*B. integrifolia*).

Related species: Swamp oak is closely related to the Western Australian swamp oak (*C. obesa*). Slight differences distinguish the two: in *C. obesa* the teeth on young shoots are appressed or slightly spreading while in *C. glauca* the teeth are longer and recurved. *C. obesa* occurs mainly in the Murchison, northern wheat belt and goldfields regions of Western Australia, with widely disjunct outliers in the Wimmera region of Victoria.

Publication: *Syst. Veg.* 3, 803 (1826). Type: New South Wales, F.W. Sieber 325.

Names: Botanical—Latin *glauca* (bluish grey or bluish green), in reference to the colour of the leaves rather than to the possession of a waxy covering. Common—refers to its usual habitats, the term oak being explained under *C. cunninghamiana*.



Bark: Greyish to light black, rough, hard, persistent; shallowly longitudinally furrowed with even shallower cross-furrows to give a tessellated appearance (1–2 cm squares). Some trees close to rivers are covered in masses of grey lichens.

Leaves: Cotyledons—sessile or slightly joined at base, elliptical, 0.2–0.3 × 0.1–1.5 cm; reddish hypocotyl covered in stubby hairs. Seedling—deciduous and permanent branches similar in morphology, whorls of 4 leaf teeth at the joints, the number gradually increasing at subsequent nodes, internodes (articles) 0.3–0.5 cm long. Adult—deciduous and permanent branches noticeably different in morphology, deciduous branchlets of uneven length, up to 30 cm long, shed after 2–3 seasons, thickish (about 0.1 cm diameter), leaf teeth in whorls of 12–16, internodes (articles) 0.8–1.5 cm long.

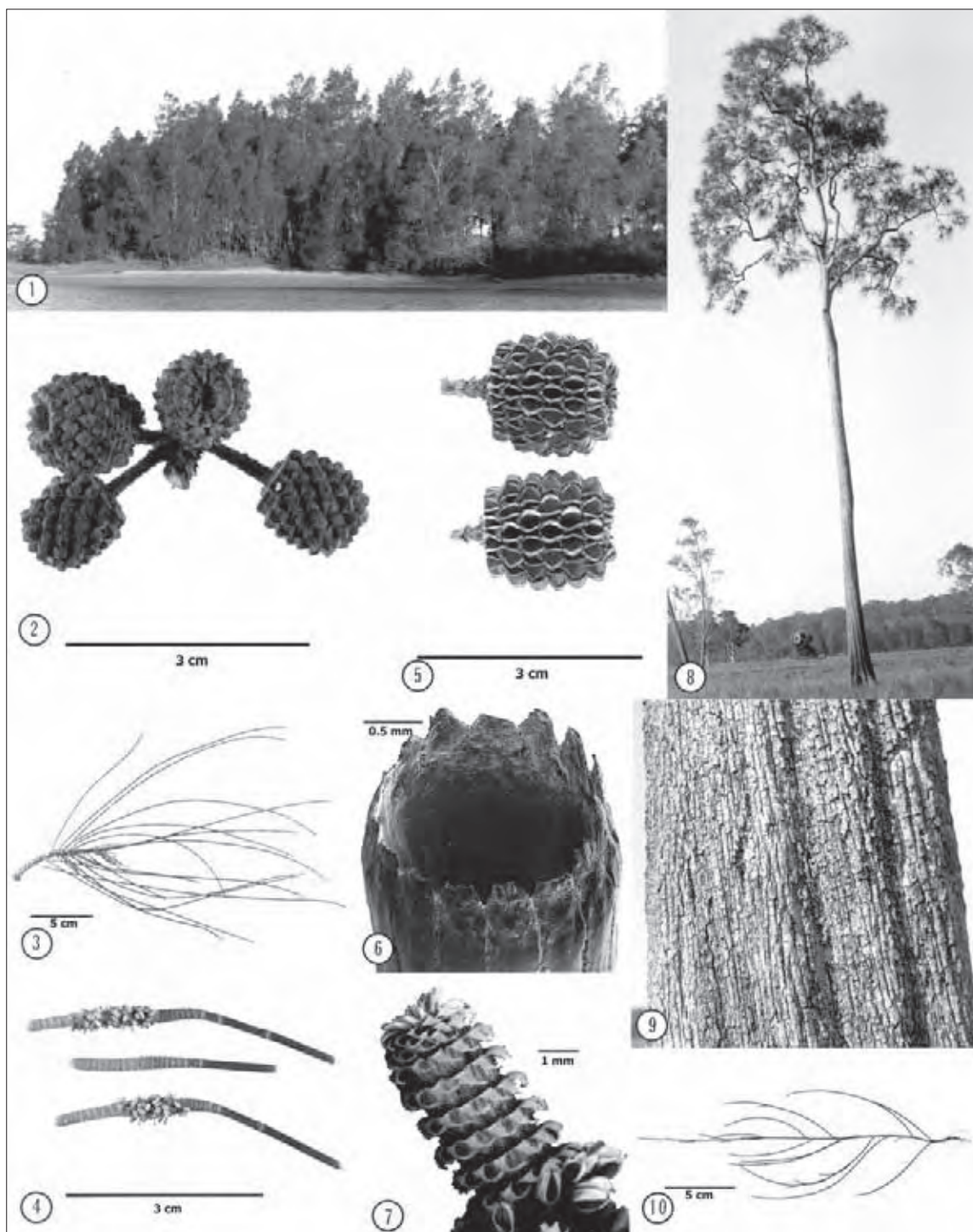
Inflorescences: Male and female flowers on separate trees. Male—grouped in whorls forming dense spikes 2–4 cm long and 0.2–0.3 cm wide at the ends of deciduous branchlets; flowers usually Sept.–Oct. Female—grouped in alternating whorls of 12–16, eventually forming a greyish subglobose to shortly cylindrical cone, 1–2 × 1–1.5 cm on a stalk about 0.4–1 cm long; fruiting cones often pubescent and bracteoles thin.

Fruits: Samaras are dull yellowish brown with some black streaks, ovate, slightly flattish, up to 0.4 × 0.2 cm, winged with brown middle and marginal vein.

Wood: Sapwood narrow, pale, not susceptible to *Lyctus* attack; heartwood brownish and has conspicuous rays, hard, tough and fissile, very dense, density 980 kg m⁻³. The species is used for handles, fencing rails, shingles, stakes, small piles in seawater and for flooring and turnery. It is an excellent fuel and is very suitable as an ornamental and for windbreaks in coastal locations.

Climate: Altitudinal range: near sea level to 90 m; Hottest/coldest month: 27–30°C/4–11°C; Frost incidence: low; Rainfall: 900–1100 mm per year, mainly summer max.

Distinctive features: Typically an estuarine *Casuarina*, with long, thick deciduous branchlets. Cones have rather thin bracteoles without markings or protuberances on their backs. Samaras are pale. The species regenerates vigorously from root suckers.



Casuarina glauca 1. Stand, Nambucca Heads, N.S.W. 2. Cones before dehiscence 3. Branchlets 4. Male inflorescences 5. Cones after dehiscence 6. Leaf teeth at joint (S.E.M.) 7. Male inflorescence, upper section, before emergence of anthers (S.E.M.) 8. Tree, near Cooperook, N.S.W. 9. Bark 10. Seedling

Nonda

Parinari nonda Benth.

Nonda is a small to medium-sized tree attaining a height of 15 m and a diameter of 0.6 m. The stem is not buttressed at the base.

Nonda occurs in Northern Territory from the Daly River region east to Arnhem Land, throughout most of Cape York Peninsula in north Queensland to as far south as the Walsh River. There are a limited number of records from the Kimberley region in Western Australia, which include the Drysdale River, Prince Regent River and Beagle Bay areas. It also occurs in New Guinea and the Solomon Islands.

Soils are variable but generally of low fertility and range from sands, red clay loams to river alluvium. They are derived from a range of substrates that include sandstone and laterite.

Nonda is a conspicuous component of the open eucalypt forests and woodlands but it also occurs on the edges of monsoon forests and rainforests. Common associates in open forests are Darwin stringybark (*Eucalyptus tetradonta*), Melville Island bloodwood (*E. nesophila*), long-fruited bloodwood (*E. polycarpa*) and variable-barked bloodwood (*E. dichromophloia*).

The fruit of nonda is edible and was once a popular food of Aboriginal people. The taste of the fruit has been described as like a mealy potato but somewhat astringent. L. Leichhardt, the Australian explorer, in his overland expedition to Port Essington reported tasting this fruit and finding it agreeable to eat.

Related species: The genus *Parinari* comprises about 50 species with pantropic distributions (Prance 1989). There are no other species of *Parinari* in Australia. Chrysobalanaceae is sometimes considered a tribe or subfamily in Rosaceae.

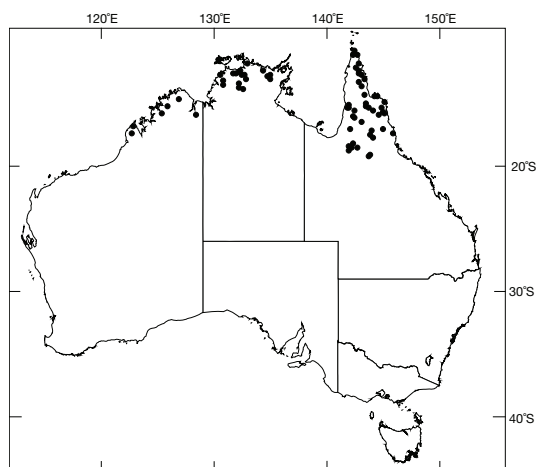
Publication: *Fl. Austral.* 2, 426 (1864). Type: as text 'N. Australia. From the Upper Lind to Van Diemen's river, Gulf of Carpentaria, Leichhardt; Gilbert river, F. Mueller. Queensland. Cape York, McGill; Albany Island, F. Mueller.'

Names: Botanical—*Parinari*, from the native name of a species in *Guiana*; *nonda*, from the Aboriginal name for a tree with a similar appearance. Common—as above.

Bark: Usually pale, somewhat fissured, flaky, tessellated to somewhat corky. The outer blaze is pink to red.

Leaves: Cotyledons—cryptocotylar. Seedling—opposite for first 2–3 pairs then alternate, sessile, ovate-elliptical to cordate, 3–5 × 2–3 cm, entire, hairy, shiny green above with scattered hairs along the veins, white tomentose beneath, discolorous; nervation reticulate, slightly visible above but prominent beneath. Each leaf has two stipules, broad at base and slightly stem-clasping, tapering to a fine point at the apex, about 0.5–1 cm long. Adult—spirally arranged; petioles 0.2–0.7 cm long; ovate, 3.5–7.5 × 1.5–5 cm, white or at least pale on the underside, 11–20 pairs of lateral veins, stipulate.

Inflorescences: Terminal and in the upper axils, paniculate. Flowers 5-merous, brownish yellow. Calyx, cup-shaped, lobes 0.1–0.15 cm long. Petals spatulate, approximately or slightly exceeding the calyx lobes. Fertile stamens 8, unequal in



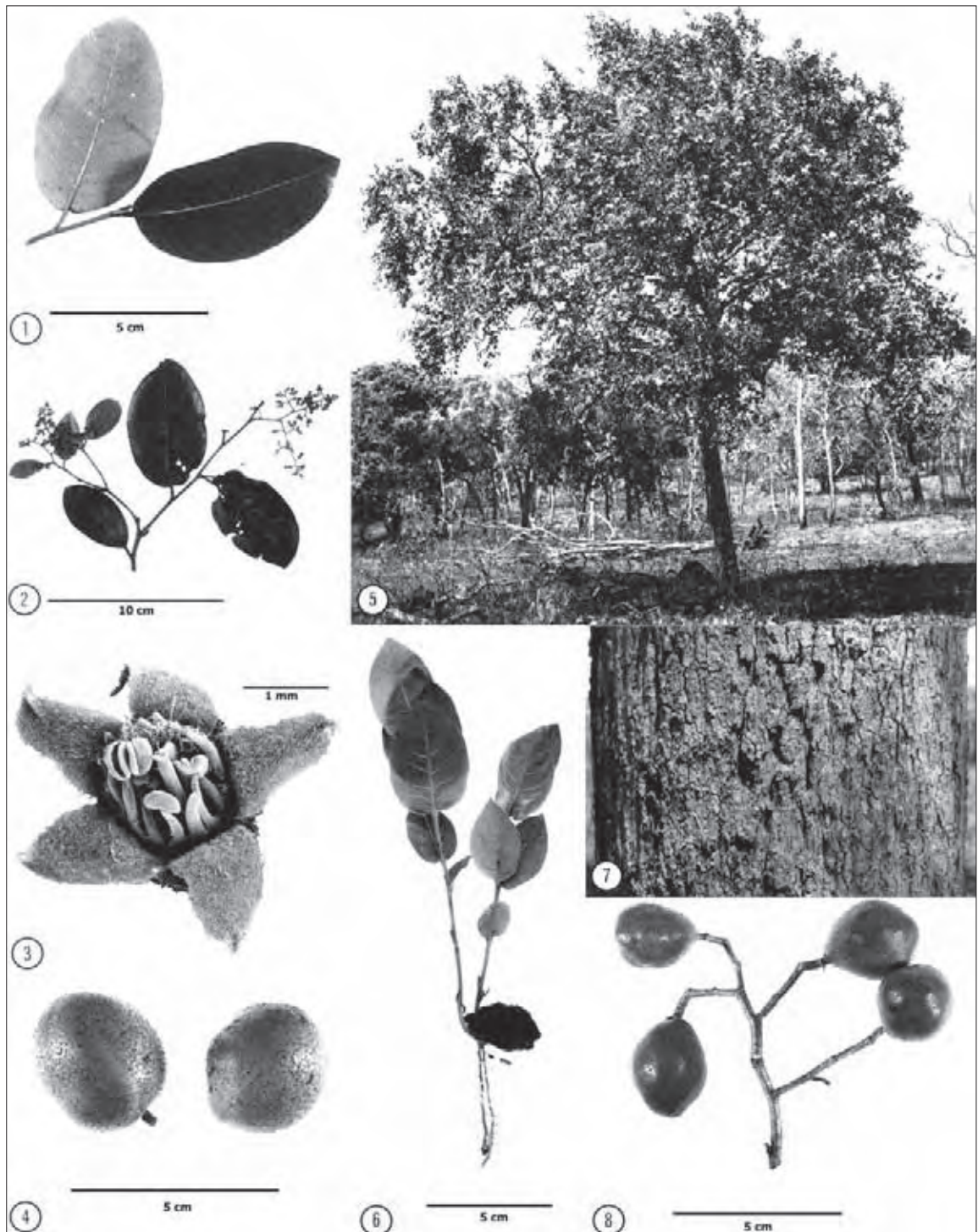
length, approximating the petals. Ovary attached to the side of the calyx tube, 2-celled with 1 ovule in each cell. Style about 0.2 cm long, arising at the base of the ovary. Stigma terminal, slightly expanded. Flowers Jul.–Oct.

Fruits: Each a drupe, brownish, globose, ovoid or ellipsoid, often flattened laterally, up to 3 cm long, rather bumpy and irregular in outline, covered by a brown scurfy layer. Pericarp mealy in texture.

Wood: Little is known about the wood of this species but it has been used as sawn timber to a limited extent on Cape York Peninsula.

Climate: Altitudinal range: near sea level to 500 m; Hottest/coldest month: 30–37°C/15–22°C; Frost incidence: low; Rainfall: 750–1650 mm per year, summer max.

Distinctive features: Small tree of open forests, leaves white or very pale on the underside, stipulate, ovary attached to the side of the calyx tube, fruit brownish, surface scurfy, rather irregular, pericarp mealy.



Parinari nondi 1. Adult leaves 2. Adult leaves and inflorescences 3. Flower (S.E.M.) 4. Fruits, mature 5. Tree, Lockerbie, Cape York Peninsula, Qld 6. Seedling 7. Bark 8. Fruits, immature

Cotton Tree

Cochlospermum gillivraei Benth.

Cotton tree is a small to medium-sized tree attaining a height of 10 m and a diameter of 0.4 m. The stem is usually without buttresses and soon breaks into the crown. Trees are deciduous for a period between July and October and the large, attractive yellow flowers usually appear when the tree is leafless.

This species has a wide distribution across north-eastern Australia. It occurs along the Queensland coast from Bowen to Cape York and also around the Gulf of Carpentaria and into the Northern Territory where it has a scattered occurrence extending west to the Darwin area and the Tiwi Islands.

Soils are rather variable, often skeletal, as the cotton tree tends to favour rocky areas but it is also found on sand ridges close to the sea.

Cotton tree occurs in monsoon forests, vine thickets and similar vegetation types. It may occur by itself on rocky outcrops but it is frequently associated with such species as tulip plum (*Pleiogynium timorense*), *Croton arnhemicus*, *Bursaria tenuifolia*, scrub turpentine (*Canarium australianum*) and tuckeroo (*Cupaniopsis anacardioides*).

Related species: There are three species of *Cochlospermum* in Australia; the other two are kapok bush (*C. fraseri*), which occurs in Western Australia, Northern Territory and Queensland, and *C. gregorii* which occurs in the Northern Territory.

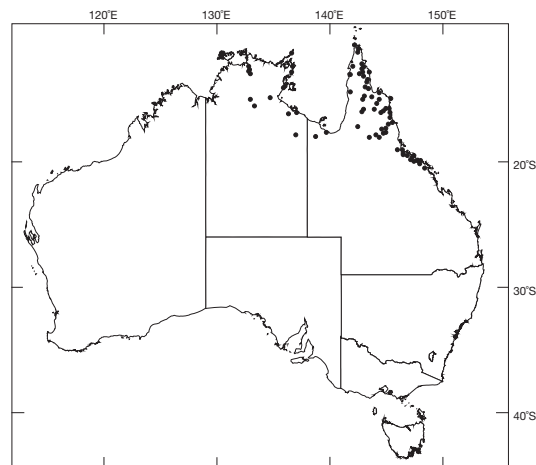
Publication: *Fl. Austral.* 1, 106 (1863). Type: Syntypes collected on Lizard Island by McGillivray, beside Burdekin River by F. von Mueller and in the Port Denison area by Fitzalan.

Names: Botanical—*Cochlospermum*, from the Greek *cochlos* (snailshell) and *sperma* (seed), alluding to the shape of the seed of some species; *gillivraei*, honours J. McGillivray (1822–1867) naturalist on H.M.S. *Fly*, *Rattlesnake* and *Herald*. Common—alludes to the cottonwool-like material around the seeds in the fruits.

Bark: Rather variable, flaky, tessellated, fissured to nondescript. Outer blaze pink coloured and marked by longitudinal stripes.

Leaves: Cotyledons—not seen. Seedling—alternate, on slender petioles to 2 cm long, first leaf simple and later leaves 3-lobed, ovate, acute, hastate, 2.5–3.5 × 1–3 cm, glabrous, green, discolorous; nervation reticulate, three-veined and visible both surfaces; root near soil surface quite enlarged. Adult—spirally arranged, petiolate, deeply palmately divided into 5–7 ovate-lanceolate or oblong-acuminate, slightly toothed lobes, each about 7 × 2 cm.

Inflorescences: Short terminal panicle. Flower buds more or less ovoid. Flowers quite large, 5-merous. Sepals very unequal, inner ones larger, about 1–1.5 × 0.8–1 cm. Petals yellow, marked by pink-red spots and short stripes, about 2–3 × 1–2 cm, bilobed at the apex. Stamens numerous, anthers yellow, about 0.3 × 0.1 cm, opening in terminal pores, filaments red, about 1 cm long. Ovary 1-celled but may appear 5-celled because of 5 placentae on walls of ovary; ovules very



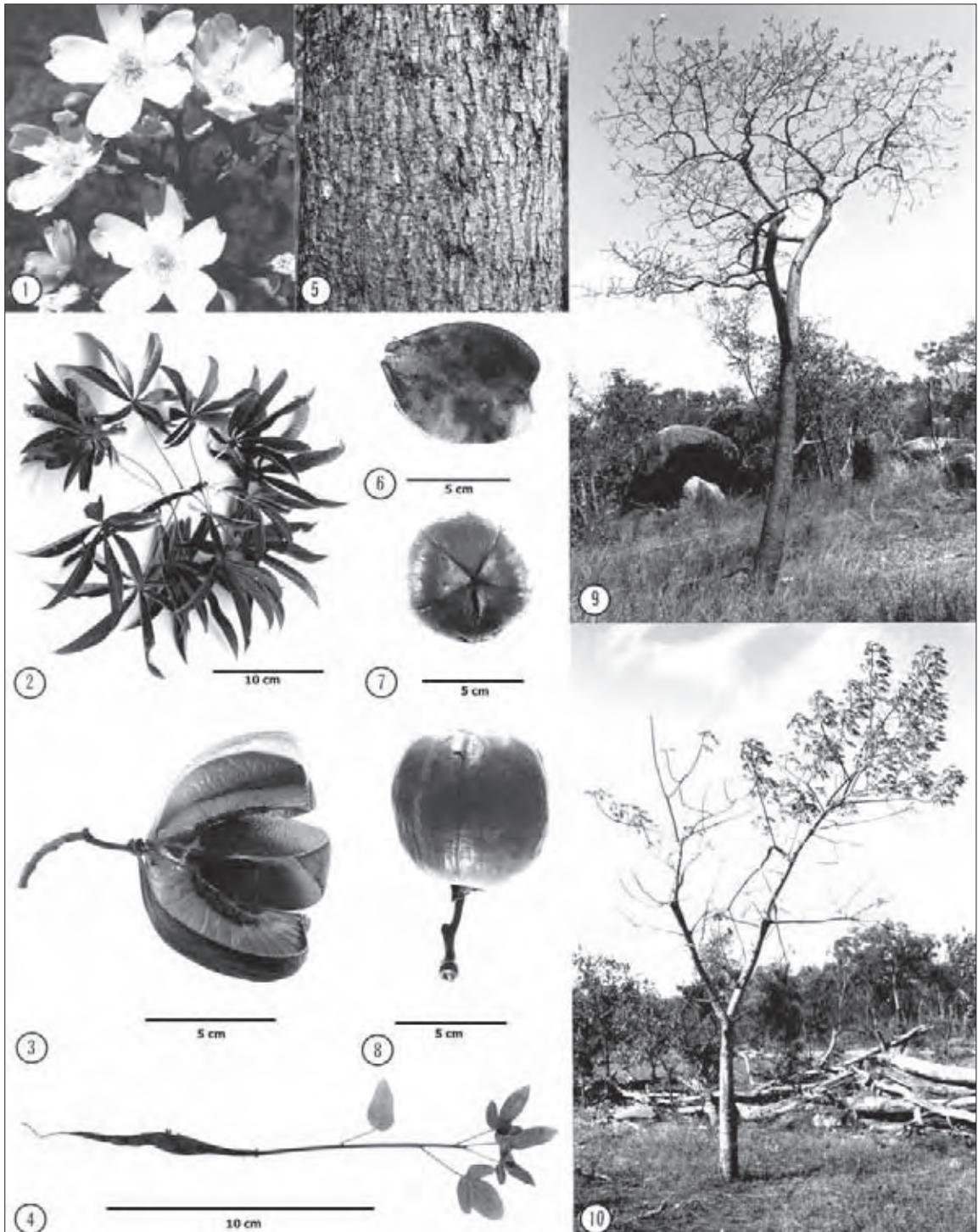
numerous. Style difficult to distinguish from anther filaments. Flowers Jun.–Sept

Fruits: Five-valved globular or barrel-shaped capsules about 8–10 cm long, containing numerous seeds immersed in a mass of fine silky hairs. Seeds dark, reniform.

Wood: Pale, soft and light, of no commercial value.

Climate: Altitudinal range: near sea level to 700 m; Hottest/coldest month: 30–38°C/14–22°C; Frost incidence: low; Rainfall: 800–2200 mm per year, summer max.

Distinctive features: Small tree growing in rocky areas, leaves palmately lobed, flowers yellow, fruit large, 5-valved, seeds surrounded by a large amount of silky hair.



Cochlospermum gillivraei 1. Flowers 2. Adult leaves 3. Fruit after dehiscence 4. Seedling with thickened root 5. Bark 6. Seed 7. Fruit (top view) 8. Fruit (side view) 9. Tree leafless and in flower, Mt Carbine, northern Qld 10. Tree in leaf

Wild Plum *Terminalia*

Terminalia platyphylla F. Muell.

This is a small to medium-sized tree, attaining a height of 20 m and a diameter of 0.3 m. The stem is usually short, soon breaking into the crown. Individual trees are usually leafless each year during the dry season (winter months) although some trees may be only semi-deciduous. The branchlets are often pendulous.

Terminalia has a wide distribution across tropical Australia from north-eastern Queensland to the Kimberley region of Western Australia.

Terminalia tends to grow on the banks of watercourses and on the margins of waterholes where it would have access to moisture reserves during the dry season. The species can occur around sinkholes in limestone areas. The soils are mainly derived from alluvia.

This species is a component of the vegetation fringing watercourses, in areas that are otherwise covered by open forests dominated by various eucalypts. Common associates along the watercourses include river red gum (*Eucalyptus camaldulensis*), northern swamp box (*Lophostemon grandiflorus* subsp. *riparius*) and silver-leaved melaleuca (*Melaleuca argentea*).

Related species: There are 24 species of *Terminalia* in Australia. *T. platyphylla* is probably most closely related to *T. ferdinandiana* with which it hybridises. A revision of Australian species of *Terminalia* was presented by Pedley (1990).

Publication: *Fragm.* 2, 150 (1861). Type: Victoria River, Northern Territory, Jan. 1856, F. von Mueller.

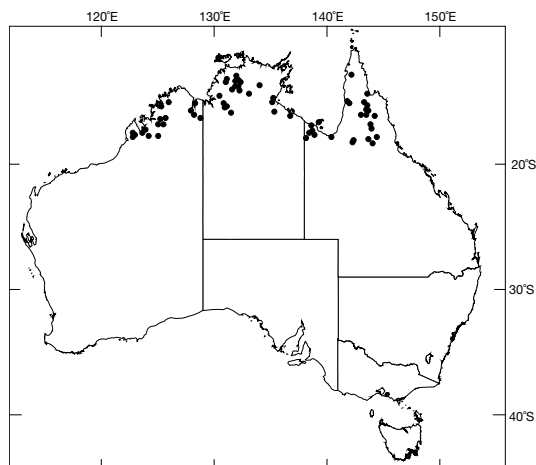
Names: Botanical—*Terminalia*, Latin *terminus* (end), alluding to the habit of trees in this genus to bear the leaves at the ends of the twigs; *platyphylla*, Greek *platys* (flat, wide, broad), *phyllon* (leaf), alluding to the broad leaves of this species. Common—after the generic name.

Bark: Grey or dark and rough; longitudinally fissured, flaky or tending to be tessellated.

Leaves: Cotyledons—petiolate (petioles to 1.5 cm long), reniform, 3–3.5 × 1.5–2 cm; trinerved, nervation prominent beneath. Seedling—alternate, petioles about 0.5–1 cm long, simple, entire, ovate-elliptic, obtuse or slightly emarginate, 3.5–9 × 1.6–5 cm, upper surface glabrous, lower surface slightly hairy on midrib and lateral veins, leaf margins ciliate, dark glossy green above, paler beneath, nervation reticulate with main lateral veins looping well in from the margin. Adult—spirally arranged, stipules absent, petioles 1.5–7 cm long, leaves generally rather large, broadly obovate to elliptical, 7–19 × 3–13 cm, 7–11 pairs of lateral veins.

Inflorescences: Pubescent spikes, with male and perfect flowers, shorter than the leaves. Flowers cream, emitting an obnoxious odour. Calyx pubescent outside, lobes deltoid, 0.15 × 0.15 cm. Petals absent. Stamens with glabrous filaments about 0.4 cm long. Ovary inferior, 2 carpels, 1-locular, 2-pendulous ovules. Style in perfect flowers to almost twice as long as the stamens. Disc villous. Flowers Oct.–Feb.

Fruits: Pseudocarps, oblong to broadly spindle-shaped, drawn out into a distinct beak at the apex. Fruit, including the beak,

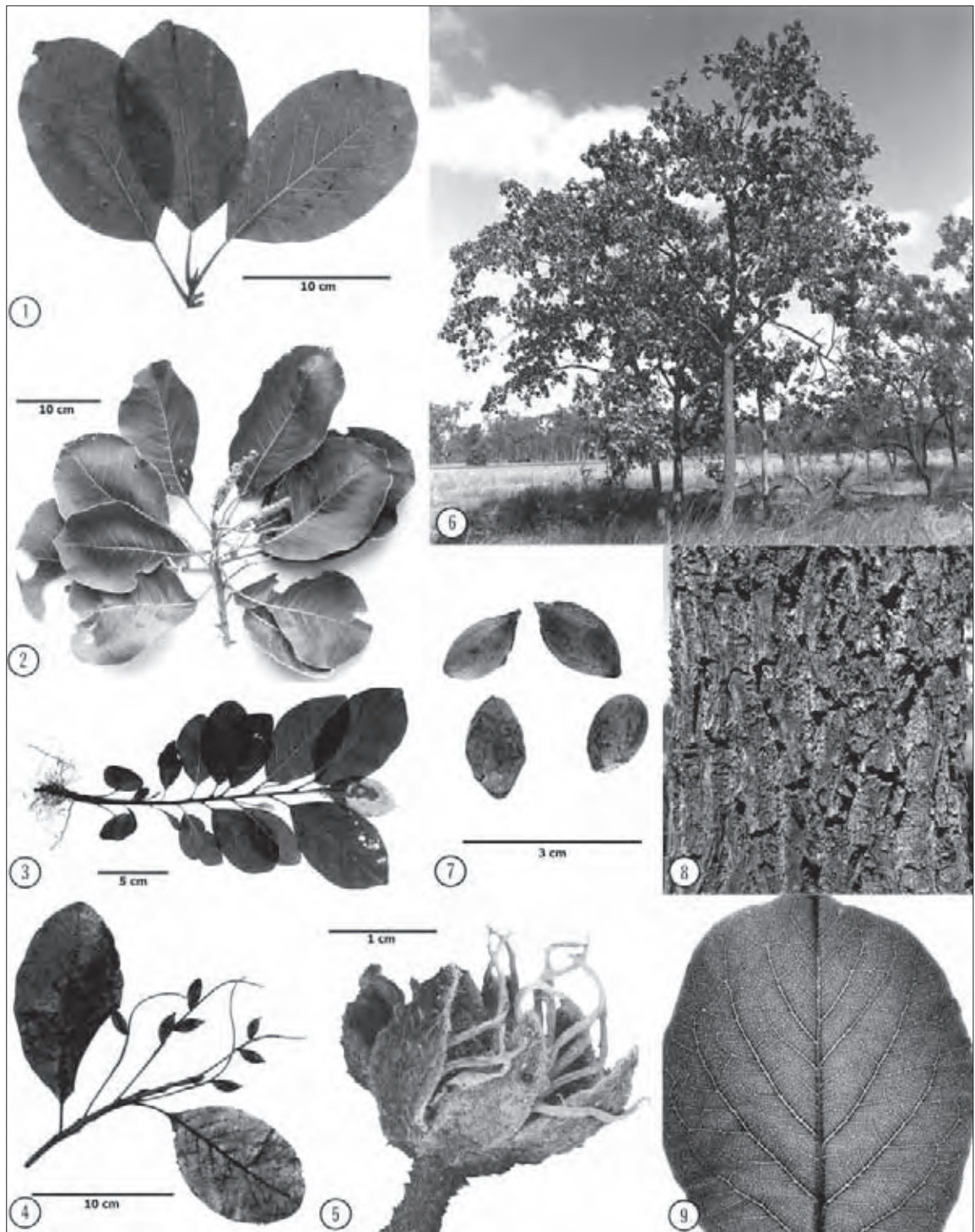


2–4 × 0.7–1.5 cm, succulent, purple but often falling while still green. Seed enclosed in the hard nut-like endocarp.

Wood: Little is known about the wood of this species as it is not utilised commercially.

Climate: Altitudinal range: near sea level to 480 m; Hottest/coldest month: 30–40°C/10–19°C; Frost incidence: low; Rainfall: 600–1500 mm per year, summer max.

Distinctive features: A dark, rough barked tree with large leaves, spicate inflorescences, stinking cream flowers, lacking petals, hairy disc and fruits with a distinct beak at the apex.



Terminalia platyphylla 1. Adult leaves 2. Adult leaves and inflorescences 3. Seedling with cotyledons 4. Fruits on branchlets 5. Flower (S.E.M.) 6. Tree, near Mt Carbine, north Qld 7. Fruits 8. Bark 9. Adult leaf nervation

Damson Sovereignwood

Terminalia sericocarpa F. Muell.

This is a medium-sized to tall tree attaining a height of 30 m with a stem diameter of 1 m. Individual trees are well-formed and typically have a buttressed stem. Trees are usually deciduous each year and are leafless for a period during September or October. The crown is broad and spreading and the branchlets have a strongly sympodial branching pattern providing the tree with a crown distinctive from a distance and even in aerial photographs.

Damson has a wide distribution across tropical Australia. It occurs along the Queensland coast from Rockhampton to Cape York and around the Gulf of Carpentaria, across to the Northern Territory and the Kimberley region of Western Australia.

The species often grows along watercourses where the amount of available water for growth is somewhat greater than the rainfall indicates. The soils vary substantially but are frequently alluvial.

Damson grows in rainforests or in gallery forests bordering watercourses particularly in the drier parts of its range. It is associated with a large number of tree species.

Related species: There are 22 species of *Terminalia* in Australia and within Australia damson most closely resembles *T. complanata*. Its closest relative is probably *T. microcarpa* of Malaysia. A revision of Australian species of *Terminalia* was presented by Pedley (1990).

Publication: *Fragm.* 9, 159 (1875). Type: Rockingham Bay, northern Queensland, J. Dallachy.

Names: Botanical—*Terminalia*, Latin *terminus* (end), alluding to the habit of trees in this genus to bear the leaves at the ends of the twigs; *sericocarpa*, Greek *sericos* (silken), plus *carpos* (fruit), referring to the fruits which are clothed in silky hairs. Common—probably alludes to its similarity to Damson plum (*Prunus instititia*).

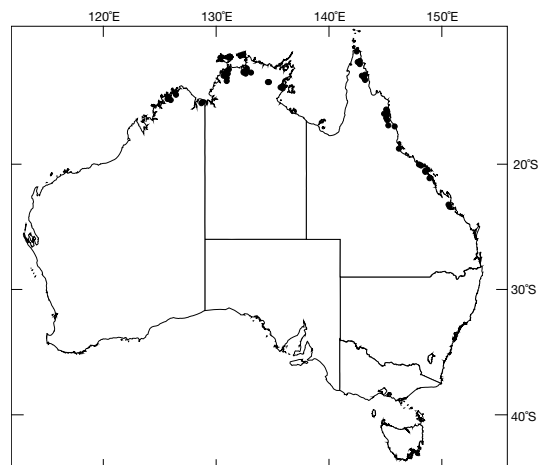
Bark: Dark and flaky, often also fissured. Outer blaze cream, pink or brown and fibrous in texture.

Leaves: Cotyledons—transversely ovate to transversely obovate. Seedling—spirally arranged, stipules absent, leaves lanceolate, narrowly obovate, usually rusty hairy on the underside. Adult—spirally arranged, petioles 0.2–1.5 cm long, glabrous at maturity, obovate to broadly obovate or elliptical, 2–20 × 1.5–8 cm, lateral veins 7–12 pairs; small translucent dots visible with the aid of a lens, these dots being mainly due to the presence of calcium oxalate.

Inflorescences: Pubescent spikes, with male and perfect flowers, about as long as the leaves. Flowers white, emitting an obnoxious odour. Calyx sericeous outside, lobes triangular 0.15 × 0.2 cm, petals absent. Stamens with glabrous filaments 0.2–0.3 cm long. Ovary inferior, 2 carpels, 1-locular, 2 pendulous ovules. Style in perfect flowers about as long as the stamens. Disc villous. Flowers Sept.–Nov.

Fruits: Pseudocarps, thinly sericeous or glabrescent at maturity, 1.3–1.8 × 0.8–1 cm wide, obscurely angled, succulent pink, red or purple. Seed enclosed in a hard nut-like endocarp.

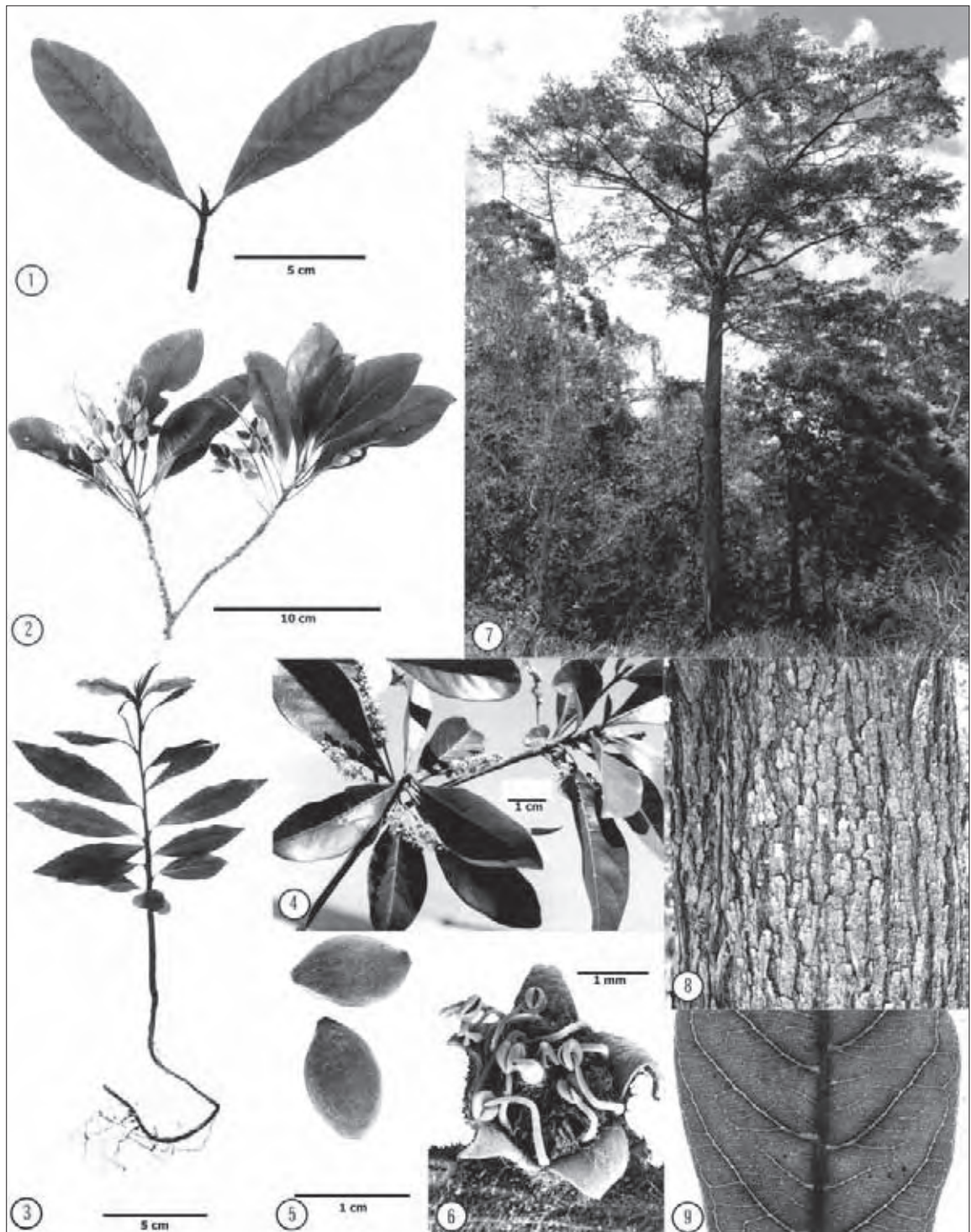
Wood: Sapwood susceptible to *Lyctus* attack; heartwood yellowish brown, pale gold usually with interlocked grain, density 640 kg m⁻³. The timber is not durable when exposed to



the weather. The wood is suitable for framing, windows and doorsills.

Climate: Altitudinal range: near sea level to 750 m; Hottest/coldest month: 30–40°C/10–22°C; Frost incidence: low-Rainfall: 950–3800 mm per year, summer max.

Distinctive features: Dark flaky bark, buttressed stem, broad spreading crown, obovate leaves, inflorescence spicate, pubescent, stinking white flowers lacking petals, hairy disc, small fruit.



Terminalia sericocarpa 1. Adult leaves 2. Adult leaves and fruits 3. Seedling with cotyledons 4. Adult leaves and inflorescences 5. Two fruits 6. A flower (S.E.M.) 7. Tree, Bamaga, northern Qld 8. Bark 9. Adult leaf nervation

Coachwood Scented Satinwood

Ceratopetalum apetalum D. Don

Coachwood is usually a medium-sized tree attaining a height of 25 m and a stem diameter of 0.9 m. The stems are pale coloured and usually cylindrical with short, small buttresses on larger trees.

This species occurs in coastal rainforests along the east coast of Australia from Benandra, near Batemans Bay, New South Wales, to just north of the border between New South Wales and Queensland. The main occurrence is from Doyles River to Forbes River and on the Dorrigo Plateau where it occurs in almost pure stands.

Coachwood occurs mainly in rainforest gullies usually on soils derived from the poorer sedimentary and metamorphic rocks. It also occurs on soils derived from rhyolite, or less commonly on red loams derived from basalt.

The species occurs as scattered trees or almost pure stands in mainly warm temperate and cool temperate rainforests. The main associated species include prickly ash (*Orites excelsa*), silver sycamore (*Cryptocarya glaucescens*), sassafras (*Doryphora sassafras*), crabapple (*Schizomeria ovata*) and, at high altitudes, negrohead beech (*Nothofagus moorei*). Coachwood may occasionally be found with kanuka box (*Tristania laurina*).

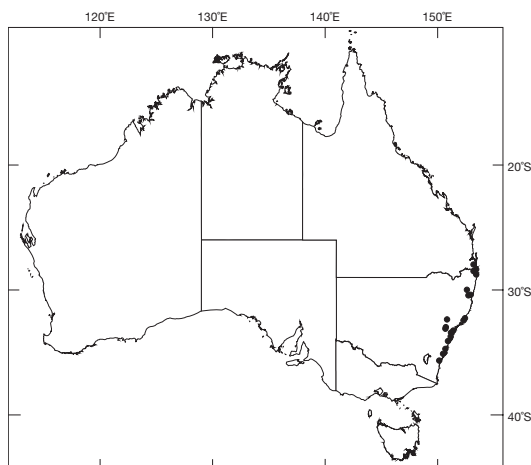
Related species: In the genus *Ceratopetalum* there are 5 other species, viz. Christmas bush (*Ceratopetalum gummiferum*), pink sycamore (*C. virchowii*), *C. corymbosum* (which occurs on Thornton Peak, near Cairns, northern Queensland), satin sycamore (*C. succirubrum*) and a recently described species from northern Queensland (*C. macrophyllum*).

Publication: *Edinburgh New Philos. J.* 9, 94 (1830). Type: Australia, George Caley.

Names: Botanical—*Ceratopetalum*, from the Greek *ceras*, *atos* (horn or antler), plus *petalon* (a petal), alluding to the horn-like petals of some species or else the antler-like petals of the type species for the genus, viz. *C. gummiferum*; *apetalum*, from the Greek *a* (without), plus *petalon* (a petal), referring to the absence of petals in this species. Common—the preferred name refers to the former use of the timber for building coaches.

Bark: Smooth, light grey, occasionally mottled in grey shades by lichen growth. The distinctive horizontal marks on the stem are believed to be due to scars originally left by the small, deciduous, interpetiolar stipules. These scars enlarge and often encircle the trunk. A cut blaze on large trees reveals a pinkish red inner bark with numerous fine paler and darker vertical lines ranging from pink to black in colour. The broken bark is very fragrant (caramel scent) and contains the compound coumarin. The bark at the base of old trees is often black and fissured.

Leaves: Cotyledons—petiolate, orbicular about 0.8×0.8 cm; hypocotyl red and glabrous. Seedling—opposite, petioles to 0.2 cm long, with the first 2–4 leaf pairs without a prominent leaf joint, lanceolate, about 3×1 cm, edges serrate, with triangular interpetiolar stipules about 0.1 cm long which are deciduous early but sheathe the stem apex initially. Adult—opposite, petioles to 1–2 cm long, compound, unifoliate rarely trifoliate, the blade attached to the petiole by a joint or articulation, lanceolate to elliptic-lanceolate, $6.5\text{--}15 \times 2\text{--}5$ cm, protracted into a long blunt point at the apex, shiny green



above, paler beneath, margins serrate; nervation visible on both surfaces but more distinct beneath where the midrib is raised; interpetiolar stipules small, triangular, early deciduous leaving a small scar.

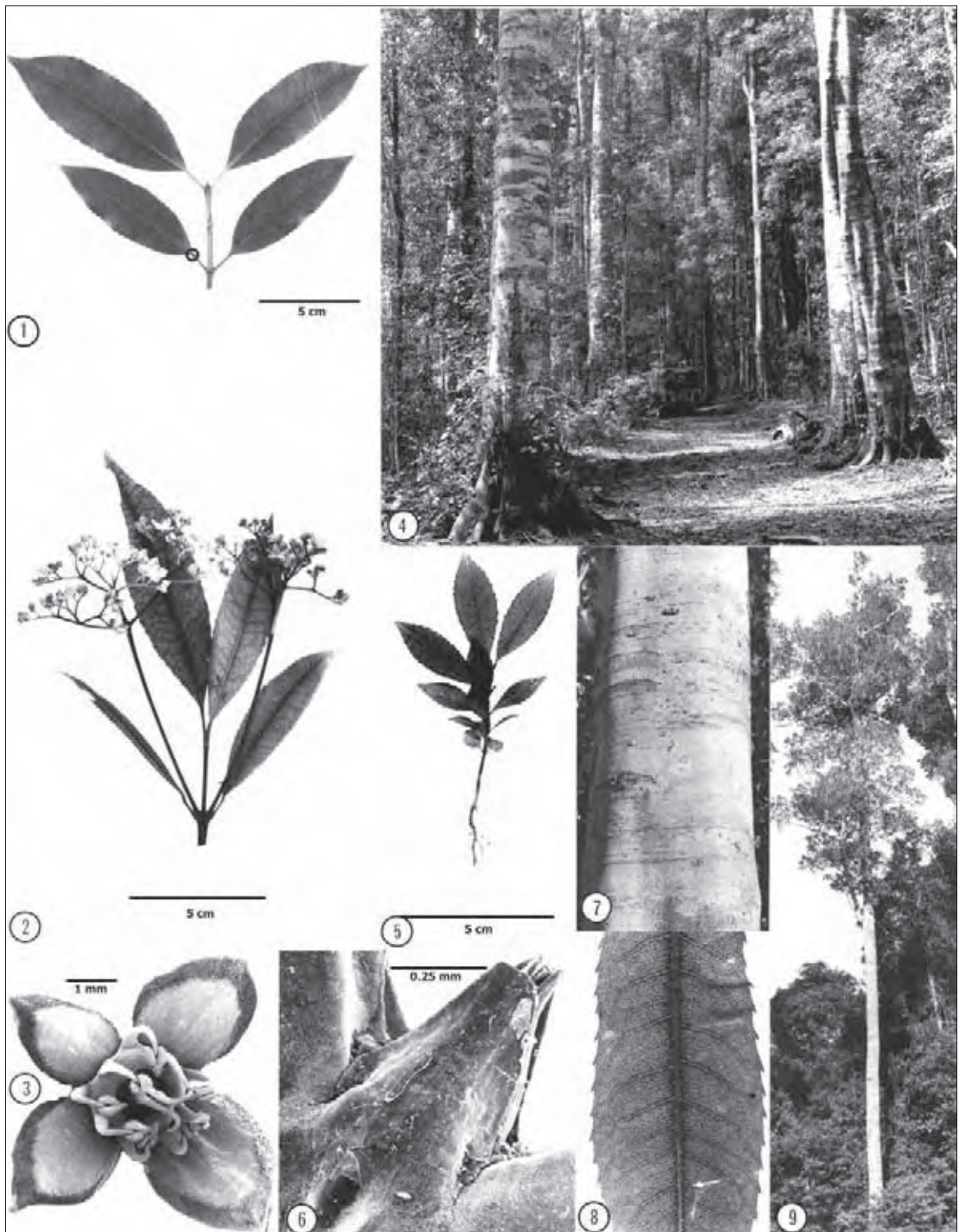
Inflorescences: Axillary corymbose cymes on stalks 8–10 cm long and covered in short hairs. Flowers, on pedicels about 0.1–0.2 cm long, about 1.4×0.7 cm, without petals but with 4–5 conspicuous, acute calyx lobes which are initially white but turn pinkish red after flowering and subsequently enlarge. Stamens 8–10, attached to the edge of a broad, flat, yellow, glistening disc about 0.3 cm in diameter, which surrounds the base of the ovary and is adnate to it. Anthers have a short spire on top and dehisce inwards. Ovary half-inferior, 2-locular, 4 ovules in each loculus; ovary has a curved bilobed style which is connate only at the base. Flowers Nov.–Dec.

Fruits: Cardboard-like in texture, egg-shaped, each 0.3 cm diameter containing 2 locules and 4 ovules, surrounded at the base by the enlarged, persistent, wing-like calyx lobes which are about 1 cm long. Style is persistent and bilobed. Fruits mature Jan.–Feb. Fruits are sown whole and seed germinates within about 18 days. The radicle is somewhat unusual in that it emerges from the top of the fruit.

Wood: Sapwood seldom attacked by *Lyctus*, largely because of the small size of the wood pores; heartwood pinkish brown in colour, fine textured, straight grained, seasons well, strong and easy to work and glue, density $470\text{--}700 \text{ kg m}^{-3}$. The wood has a characteristic and pleasant caramel scent and is highly regarded as a cabinet timber; in the past it was used extensively for plywood, veneers, joinery, furniture, lining, turnery and carving. The timber is often highly figured on the backcut face owing to bands of soft tissue. Coachwood stands were extensively logged during World War II for use as rifle butts and veneers for the manufacture of the Mosquito fighter-bombers.

Climate: Altitudinal range: 100–900 m; Hottest/coldest month: $26\text{--}30^\circ\text{C}/1\text{--}5^\circ\text{C}$; Frost incidence: low but moderate at higher elevations; Rainfall: 1000–2000 mm per year, summer max.

Distinctive features: Fragrant scent of the wood, pale, smooth bark with circular rings, distinctive articulate joint at the base of the serrate leaf, interpetiolar stipules.



Ceratopetalum apetalum 1. Adult leaves in pairs with the approximate position of the leaf articulation indicated by a circle 2. Inflorescence 3. Flower (S.E.M.) 4. Stand, Enfield State Forest, west of Wauchope, N.S.W. [photograph by courtesy of Forestry Commission of N.S.W.] 5. Seedling 6. Interpetiolar stipules (S.E.M.) 7. Bark indicating rings 8. Adult leaf nervation 9. Tree, Dome Mtn, near Dorrigo, N.S.W.

Red Carabeen

Geissois benthamiana F. Muell.

Red carabeen is usually a tall tree attaining a height of 30 m and a stem diameter of 1 m. The trunk is cylindrical with narrow transverse ridges and is usually buttressed at the base. The crown is large and compact, consisting of glossy green foliage.

This species occurs mainly in New South Wales. The southern limit is the Manning River near Taree, New South Wales, and the northern limit is around Tambourine Mountain, Queensland.

The species prefers gullies in rainforests and occurs on the less fertile soils that have increasing clay with depth derived from sedimentary material; it is also common on more fertile clay loams derived from basalt, as in Wangaree State Forest near Casino, New South Wales.

Red carabeen occurs in mainly subtropical rainforests (complex notophyll vine forests) but also in warm temperate rainforests (simple notophyll vine forests). The main associated tree species include booyong (*Argyrodendron* spp.), yellow carabeen (*Sloanea woollsii*), crabapple (*Schizomeria ovata*) and socketwood (*Daphnandra* spp.).

Related species: Red carabeen belongs to the family Cunoniaceae. There are two tree species of *Geissois* in Australia, the other being northern brush mahogany (*G. biagiana*), which occurs in northern Queensland.

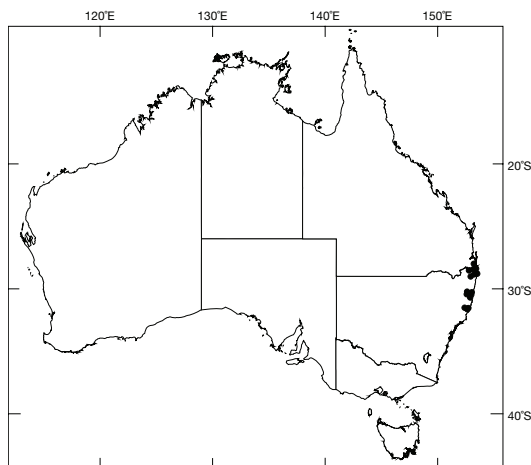
Publication: *Fragm.* 5, 16 (1865). Type: Near Hastings River by Beckler, and Duck Creek by C. Moore, both in New South Wales.

Names: Botanical—*Geissois*, from the Greek *geisson* (a projecting part of the roof), alluding to the overlapping arrangement of the seeds in the fruit; *benthamiana*, honours G. Bentham (1800–1884), a famous English botanist and author of *Flora Australiensis* (1863–78). Common—believed to be of Aboriginal origin with red being the colour of the heartwood.

Bark: Brown to dark brown, smooth, sometimes slightly wrinkled, with small pustules, inner bark deep red to brown, paler near the sapwood.

Leaves: Cotyledons—petiolate about 0.2 cm long, elliptical, about 0.5 × 0.4 cm; hypocotyl and cotyledons covered in small, white hairs. Seedling—opposite, petioles to 4–5 cm long, first 6 pairs simple, acuminate, obovate 7–15 × 3–6 cm, serrate, later pairs trifoliate with terminal leaflet petiolate (petiolule 1 cm long); large stipules, about 2–3 cm wide; nervation reticulate, prominent both surfaces but raised beneath; seedlings and small saplings often have finely hairy petioles and stems. Adult—opposite, petioles to 2–3 cm long, trifoliate, leaflet petiolules about 0.5–0.8 cm long, elliptical, acuminate, 7–16 × 2–5 cm, serrate, green both surfaces, glabrous; lateral veins visible both surfaces, but more prominent on underside, net veins not prominent; stipules at base of petiole in pairs, rounded, oblique, about 1–2.5 cm diameter.

Inflorescences: Axillary racemes, slender, 9–15 cm long. Flowers about 0.6 cm long, on pedicels about 0.2 cm long, finely downy. Calyx finely downy, divided into 5–6 lobes, 0.3 cm long, petals absent. Stamens 20–30, about 0.6 cm long,



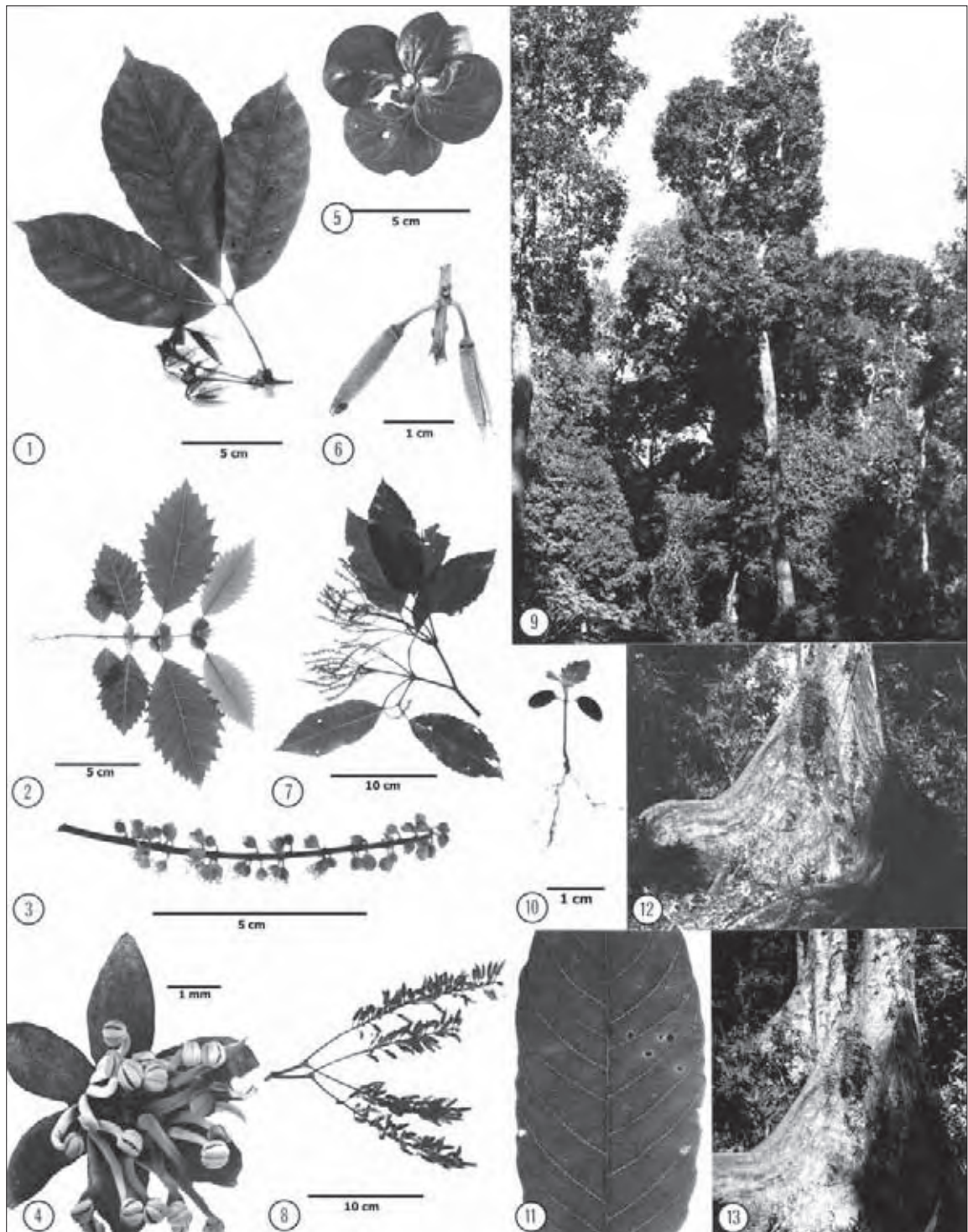
bristle-like. Ovary egg-shaped, silky-hairy and surmounted by 2 slender styles. Flowers Nov.–Jan.

Fruits: Light brown capsules, silky downy, elliptical-cylindrical, 1.5–2 × 0.3–0.5 cm, 2-celled, separating from summit to near base. Several overlapping seeds in each cell, flattish, about 0.5 × 0.1 cm with a terminal wing about 0.2 cm long. Mature May–Jul.

Wood: Sapwood pale yellow and generally quite narrow for a rainforest species, about 3 cm wide and sometimes attacked by *Lyctus*; heartwood light to dark pinkish brown, straight grained, fine textured, density 530–730 kg m⁻³. The wood is prone to warping and needs careful stacking when drying. In the past the timber was used to make very attractive furniture, internal joinery and plywood.

Climate: Altitudinal range: 100–1000 m; Hottest/coldest month: 27–30°C/4–6°C; Frost incidence: low to moderate; Rainfall: 1000–1700 mm per year, summer max.

Distinctive features: Trifoliate leaves with serrate leaflets, large rounded stipules at the base of the petioles, red blaze of the inner bark, sapwood surface which becomes yellow on exposure, and cylindrical, capsular fruit. The large stipules are very distinctive on seedlings.



Geissois benthamiana 1. Adult leaf with two new adult leaves 2. Seedling with stipules 3. Part of an inflorescence 4. Flower (S.E.M.) 5. Pair of seedling stipules 6. Two fruits, one closed and one opened 7. Branchlet with inflorescences 8. Fruits 9. Tree, Wiangaree State Forest, near Kyogle, N.S.W. 10. Seedling with cotyledons 11. Adult leaf nervation 12, 13. Tree buttresses

Crabapple White Birch, White Cherry (Qld)

Schizomeria ovata D. Don

Crabapple is a tall tree up to 30 m in height with a stem diameter of 1–2 m. The trunk is cylindrical, often slightly buttressed at the base of larger trees, and the crown is compact with a rounded dense canopy of light green foliage.

Crabapple is found as scattered trees in rainforests from Mt Dromedary near Narooma, New South Wales, to Fraser Island. It also occurs on the Eungella Ranges west of Mackay and near Tully Falls. The species reaches its best development on the Dorriggo Plateau, New South Wales, and the Killarney Ranges, Queensland.

The species occurs mainly in sheltered positions but also in exposed positions such as in the eastern Dorriggo and Washpool areas of New South Wales. The soils are generally of low fertility, being derived from shales and other sedimentary material. Crabapple also occurs on more fertile alluvial soils and red clay loams derived from basalt.

Crabapple occurs in mostly warm temperate rainforests (simple notophyll vine forests) but also in subtropical (complex notophyll vine forests) and cool temperate rainforests (microphyll fern forests). On soils of poor fertility the most common associated species is coachwood (*Ceratopetalum apetalum*).

Related species: Crabapple is one of two tree species of *Schizomeria* in Australia. The other is white birch (*S. whitei*), which occurs in Queensland and has large leaves up to 15 cm long with recurved margins and inconspicuous teeth on the leaf edges.

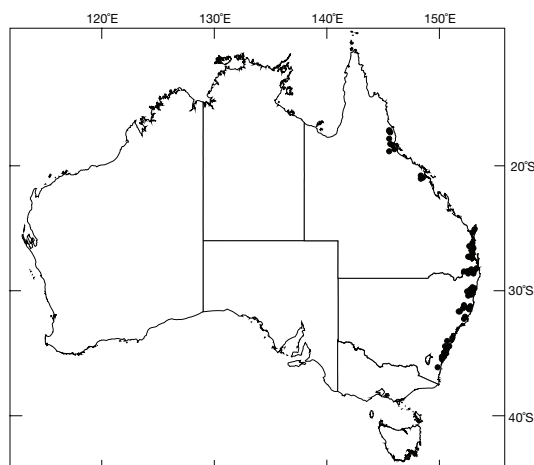
Publication: *Edinburgh New Philos. J.* 9, 95 (1830). Type: Australia, George Caley.

Names: Botanical—*Schizomeria*, from the Greek *schizo* (to split), plus *meros* (share, a part), in allusion to the petals which usually appear as if pieces have been cut out; *ovata*, egg-shaped, of the leaves. Common—crabapple refers to the similarity of fruit to that of the other crabapples (*Malus* spp.).

Bark: Grey, smooth to wrinkled in small to medium-sized trees, becoming deeply furrowed, hard and tough on larger and older trees. A thick red gum exudes from the surface soon after the bark is blazed.

Leaves: Seedling—opposite, petioles to 2–3 cm long, simple, lanceolate, acuminate, 3–5 × 3–4 cm, edges serrate. Adult—opposite, petioles to 1–2.5 cm long and swollen at the base, simple, ovate to ovate-lanceolate, obtuse or acuminate, 7–15 × 3–8 cm, with irregular obtuse teeth, shortly narrowed at the base, glossy green, discolorous; nervation visible both surfaces, raised beneath; stipules small, up to 0.5 × 0.2 cm, glabrous, from ovate to lanceolate, soon shed to leave a scar encircling the stem near the base of the petiole; there is a form with entire leaves on Browns Knob near Barcoongere State Forest, Coffs Harbour district.

Inflorescences: Axillary cymes of white flowers. Calyx 4–5 lobed and slightly hairy at the apex of the sepals. Petals shorter than the calyx, toothed or lobed at the end. Stamens 8–10 inserted outside an 8–10 lobed disc and between the lobes.



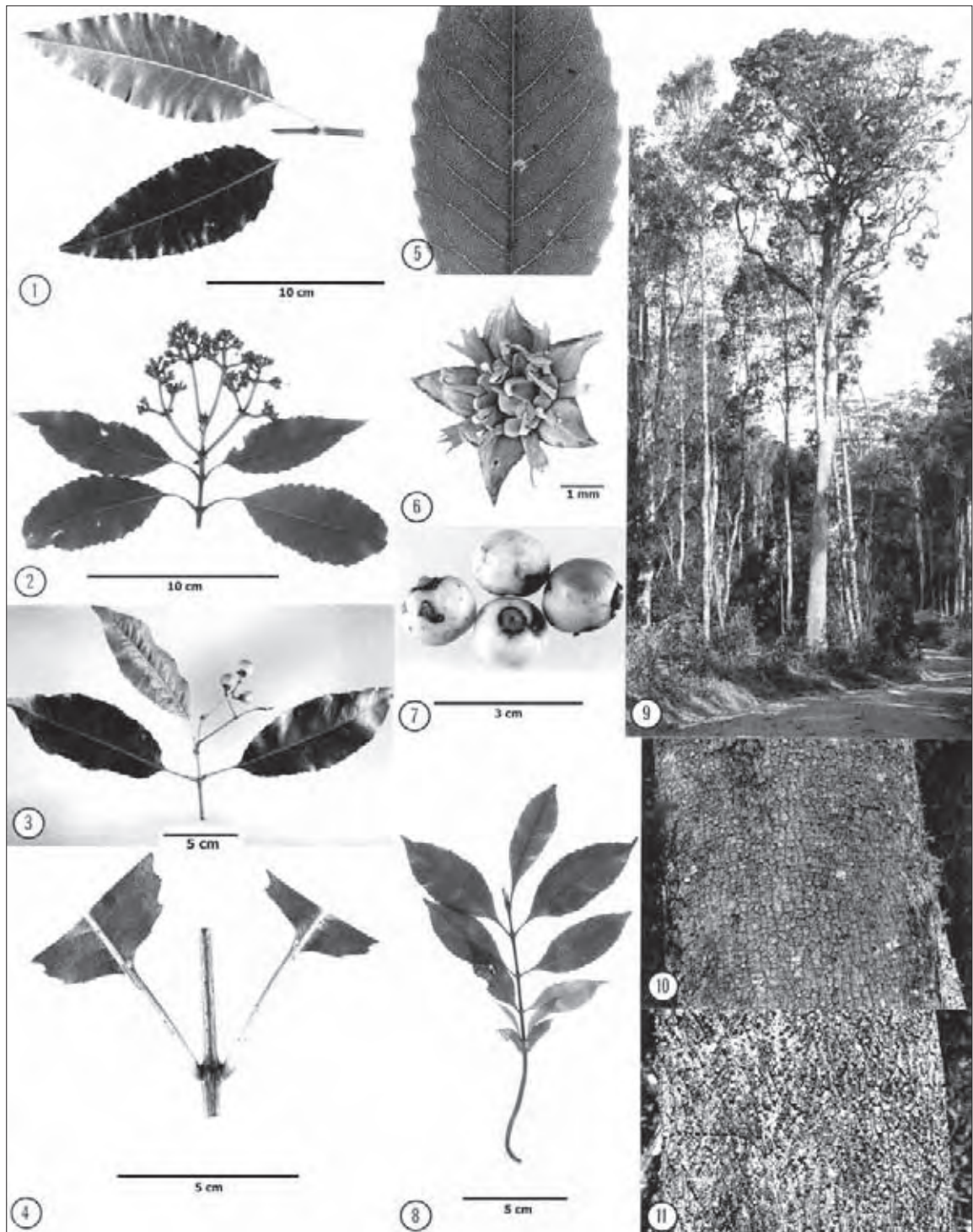
Ovary 2-locular, free except at the broad base. Styles 2 and distinct, short, recurved. Flowers Sept.–Oct.

Fruits: Drupes, ovoid to globular 1–2 cm diameter, whitish, outer part fleshy with a sharp acid flavour, inner part hard, 2-celled with each cell containing 1 seed that is quite difficult to germinate. Mature Feb.–Jul.

Wood: Sapwood not always clearly differentiated and may be up to 15 cm wide; it is very susceptible to *Lyctus* attack. Heartwood colour is variable and is usually light grey-brown but often has pink and also blue tints, grain usually straight but may be interlocked, texture fine, density 500–720 kg m⁻³. The timber is not durable. It is easily worked, peels and turns well, glues readily and is easily stained.

Climate: Altitudinal range: 150–1000 m; Hottest/coldest month: 26–30°C/1–5°C; Frost incidence: low to moderate; Rainfall: 1000–2000 mm per year, uniform to summer max.

Distinctive features: Astringent taste of the bark, sharp acid flavour of the succulent, white apple-like fruits and glossy green, opposite, simple leaves with toothed margins.



Schizomeria ovata 1. Adult leaves, upper and lower surfaces 2. Adult leaves and inflorescence 3. Adult leaves and fruit 4. Adult leaves indicating the absence of joints on the petiole 5. Adult leaf nervation 6. Flower (S.E.M.) 7. Fruits 8. Seedling, collected in the field 9. Tree, Cangai State Forest, near Grafton, N.S.W. 10. Bark, old tree 11. Bark, young tree

Silver Quandong Blue Quandong, Blueberry Ash, Blue Fig

Elaeocarpus angustifolius Blume

Silver quandong is a tall tree attaining 35 m in height and stem diameters of about 2 m. The stem is prominently buttressed at the base. The crown is rather open in appearance and the leaves are usually displayed stiffly in small finger-like tufts. The older dead and senescent leaves in the crown are bright red and contrast with the live leaves of the canopy.

Silver quandong occurs along the eastern coast of Australia from the Taree area, New South Wales, to near Maryborough, Queensland. Farther north small populations occur on the Eungella Ranges, west of Mackay, and near Proserpine. It also occurs between Ingham and Cooktown and on Cape York Peninsula with occurrences near Coen, McIlwraith Range and Bamaga. Unusual isolated and widely disjunct stands are found beside the mouth of the Daly River and on the Tiwi Islands in Northern Territory.

In the southern parts of its range, silver quandong grows typically along the banks of creeks, but in higher rainfall areas in the northern parts of its distribution it is less habitat specific. The soils are usually derived from alluvia or occasionally basalts.

Silver quandong occurs in subtropical to tropical rainforests. Associated species commonly found growing with silver quandong include yellow carabeen (*Sloanea woollsii*), booyong (*Argyrodendron* spp.), rosewood (*Dysoxylum fraserianum*), red cedar (*Toona ciliata*), *Flindersia* spp. and white beech (*Gmelina leichhardtii*).

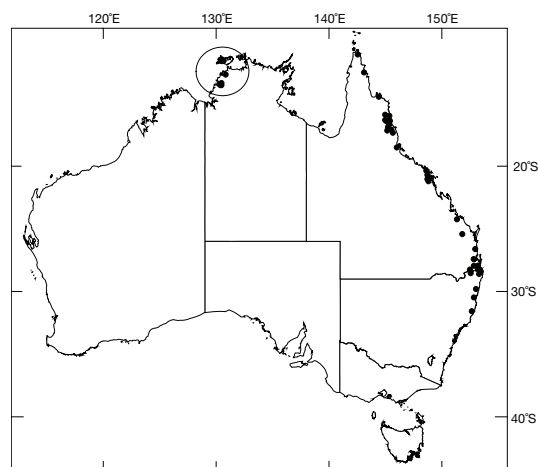
Related species: *E. reticulatus* and *E. obovatus*. *E. reticulatus* differs in the strongly reticulate nervation, the more regularly spaced leaf teeth, white to pink flowers, more elliptical-shaped fruit. *E. obovatus* has small leaves (5–7 cm long), toothed leaf margins, white petals and dark blue fruit.

Publication: *Bijdragen tot de Flora van Nederlandsch Indie* 120, (1827). Type: Java.

Names: Botanical—*Elaeocarpus*, from the Greek *elaia* (the olive tree), plus *karpus* (fruit), probably alluding to the similarity of the fruit of the first-named species in the genus to that of the olive; Latin *angusti* (narrow), Latin *folium* (leaf), in reference to the narrow leaves. Common—quandong refers to the similarity in shape of the fruits of this species to that of true quandong (*Santalum acuminatum*).

Bark: Grey, rather smooth, slightly wrinkled on large trees, not scaly but has small longitudinal fissures. The dead bark is rather thin. The cut blaze is yellowish brown becoming light yellow towards the sapwood, somewhat granular in texture.

Leaves: Cotyledons—cryptocotylar. Seedling—alternate, petioles to 0.3–0.5 cm long, simple, elliptical to narrow-elliptical, acute to acuminate, 3–19 × 1–3.5 cm, margins serrulate, glabrous, green, discolourous; nervation, reticulate, midrib and lateral veins prominent both surfaces; foveolae present in the axils of the midrib and lateral veins. Adult—alternate; petioles to 1–1.5 cm long; elliptical, narrowed at both ends, 8–12 × 2–3 cm, margins finely toothed, discolourous; midrib, lateral veins and net veins visible on both surfaces; stem distinctly ridged below each leaf insertion;



stipules small and caducous; foveolae in the axils of the midrib and lateral veins have a characteristic elliptical entrance.

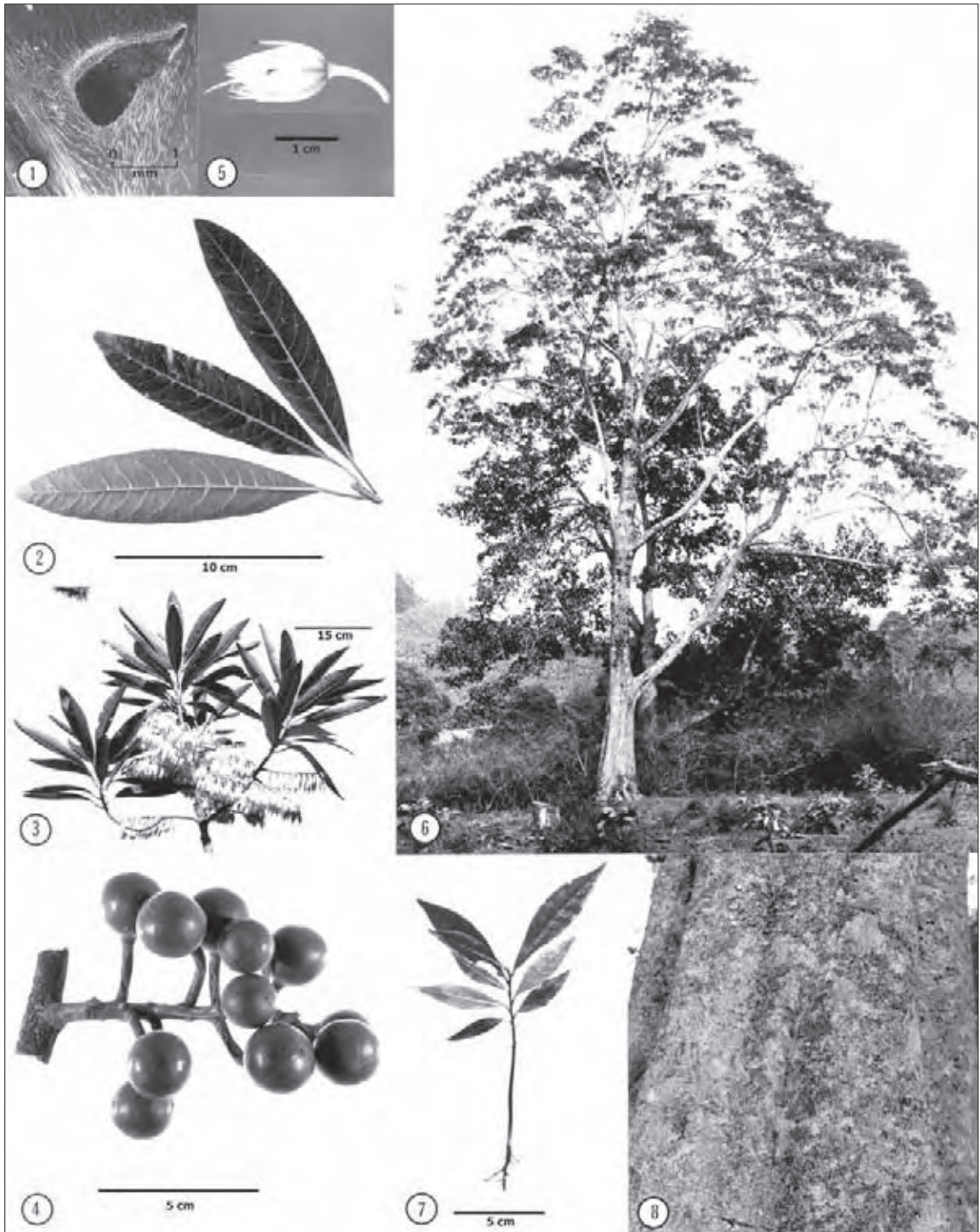
Inflorescences: Narrow racemes 5–10 cm long, arising from the branchlets near the scars of the fallen leaves and behind the leaves. Flowers often turned to one side giving the raceme a distinctive one-sided pendulous appearance. Flowers 1–2.5 cm long, with 5 narrowly pointed sepals about 1 × 0.3 cm; 5 creamy-white petals alternate with the sepals; petals slightly longer than the sepals and about twice as broad. Apices of the petals are fringed consisting of 10–20 narrow segments of irregular length but up to one-third of the length of the petals. There are 5 compact bundles of 12–14 brown, bristle-like stamens per bundle; each stamen consists almost entirely of the anther, which is about 0.5–0.7 cm long on a very short filament. Pollen is discharged through a terminal slit. Stamens are finely tubular and covered with very minute hairs. Ovary and base of style covered with silky hairs. Style relatively long, about 1.5–2 cm in length, often protruding about 0.5 cm beyond the tips of the petals. Stamens and ovary situated on a hairy, lobed, perigynous disc. Flowers May–June.

Fruits: A drupe, globular, bright blue, up to 3 cm diameter, outer part fleshy enclosing a very hard 'stone' with a deeply wrinkled surface. The 'stone' contains 5 locules each containing a single, dark-coated, narrowly oval seed about 1 cm long.

Wood: Sapwood is similar in colour to heartwood and is up to 10 cm wide, and susceptible to attack by *Lyctus*; heartwood is white to straw-coloured, straight grained, uniform to coarse-textured, density about 465 kg m⁻³. The wood is easy to glue and stain and is very suitable for bent work. The timber, now largely cut out, was used for plywood, furniture, joinery, racing oars, boat planking and for light aircraft.

Climate: Altitudinal range: near sea level to 500 m; Hottest/coldest month: 28–33°C/5–18°C; Frost incidence: low (but up to 5 per year at some sites); Rainfall: 1000–3500 mm per year, summer max.

Distinctive features: A rainforest tree with stiff, serrulate adult leaves that turn red as they die, fringed flowers that are pendent on one side of the raceme; smooth, blue fruits.



Elaeocarpus angustifolius 1. Foveolae on underside of leaf (S.E.M.) 2. Adult leaves with foveolae at major junctions of veins 3. Flowering branch showing pendulous nature of flowers 4. Fruits 5. Flower 6. Tree, near Coffs Harbour, N.S.W. 7. Seedling 8. Bark

Yellow Carabeen Carabeen

Sloanea woollsii F. Muell.

Yellow carabeen is a tall to very tall rainforest tree attaining a height of 55 m and a stem diameter of 2.5 m. The stem is prominently buttressed at the base with the buttresses sometimes extending about 4 m up the stem. The buttress is typically convex in outline, a distinctive feature in the rainforests of New South Wales. The crown is often spreading with numerous sub-erect branches; the dense canopy consists of light yellow-green leaves.

This species is found in New South Wales from the Gloucester area to the Macpherson Ranges with the main areas of occurrence being Acacia Plateau, Carrai State Forest and Wiangaree State Forest. In Queensland, it occurs in the ranges around Killarney, Mistake Ranges, Mount Tambourine and as far north as Gympie.

Yellow carabeen grows on mostly well-drained sites in rainforest situations. It prefers fertile soils and is found on soils derived from basalt and rich alluvium.

It occurs mainly in subtropical (complex notophyll vine forests) but also in warm temperate (simple notophyll vine forests) rainforests. The sites are similar to the booyong (*Argyrodendron* spp.) rainforest, yellow carabeen generally being found in higher and more exposed localities and often being the dominant species. Common associates include rosewood (*Dysoxylum fraserianum*), red cedar (*Toona ciliata*), prickly ash (*Orites excelsa*) and giant stinging tree (*Dendrocnide excelsa*). There is an unusual association of yellow carabeen with negrohead beech (*Nothofagus moorei*), west of Wauchope, New South Wales.

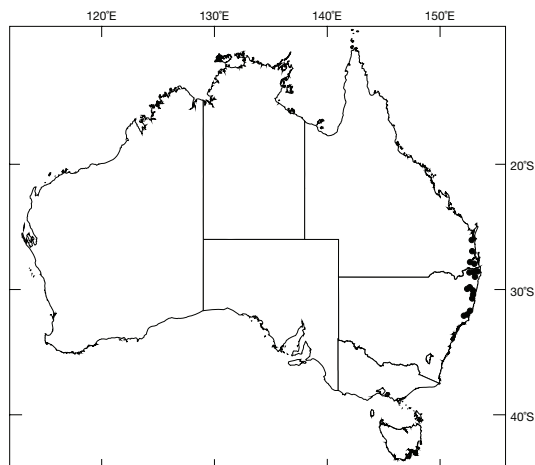
Related species: There are only four species of *Sloanea* in Australia. *S. woollsii* differs from Maiden's blush (*S. australis*) and white carabeen (*S. langii*), in lacking petals, and from northern yellow carabeen (*S. macbrydei*), in that the leaves of the latter are obovate and the margins more crenulate than toothed. There are several other species of *Sloanea* in Brazil, Venezuela, Cuba and Jamaica.

Publication: *Fragm.* 6, 171 (1868). Type: Tweed River area, New South Wales, Moore and Carron 34.

Names: Botanical—*Sloanea*, honours Sir Hans Sloane, principal founder of the British Museum; *woollsii*, honours Rev. Dr W. Woolls (1814–1893), schoolmaster and botanist in New South Wales. Common—yellow being the wood colour, and carabeen being of Aboriginal origin.

Bark: Grey or brownish grey, mostly wrinkled or grooved and with clusters of close-spaced horizontal lines around the trunk. The vertical lines of raised pustules are most distinctive. The blaze is reddish brown becoming lighter towards the sapwood, with an unpleasant odour. The outer half of the blaze is patterned by paler vertical bands and lines.

Leaves: Cotyledons—petioles about 0.5 cm long, elliptical, about 3 × 2 cm. Seedling—alternate, petioles about 0.5 cm long, lanceolate, up to 5–8 × 2–3 cm, margins serrulate. Adult—alternate, petioles to 1–4 cm long, unifoliate, elliptical to ovate acuminate, 7.5–12.5 × 2.5–3 cm, jointed at base of leaf (articulated), toothed margins, glabrous; nervation



visible both surfaces, raised on undersurface; foveolae present in axils of midrib and lateral veins.

Inflorescences: Axillary racemes, generally shorter than the leaves, pedicels 1–2 cm long. Sepals 4–5, rhomboid-orbicular, slightly imbricate, velvety both surfaces, petals absent. Stamens about 20, bristle-like, very narrow, about 0.25 cm long, anthers covered with minute hairs, filaments very short. Ovary elliptical, hairy, tapering into a short style; ovary and stamens seated on a hairy disc. Flowers Oct.–Nov.

Fruits: Capsules, yellow-brown, oval, about 2 cm long, 2-celled, splitting into 2 valves covered on the outside by rigid, slender prickles about 0.8 cm long. Seeds shiny black, about 0.6 cm long, solitary in each cell, almost completely covered by an orange to red-brown aril. Mature Mar.–Jul.

Wood: Sapwood not always clearly differentiated but the narrow very pale outer wood is very susceptible to *Lyctus* attack as well as the pale yellow-coloured wood (possibly intermediate-heartwood zone); heartwood light yellow to yellow-brown, uniform texture, density about 595 kg m⁻³. The wood is fairly easy to work and was used for plywood, joinery, furniture and turnery.

Climate: Altitudinal range: 30–1000 m; Hottest/coldest month: 26–30°C/5–8°C; Frost incidence: mainly low but ranging to high at upland sites; Rainfall: 1000–2000 mm per year, summer max., but useful falls occur most months.

Distinctive features: Very large convex buttresses; yellow-green articulated leaves with toothed edges and hairy foveolae; woody, prickly coated, 2-valved fruits.



Sloanea woollsii 1. Bark showing vertical lines of lenticels 2. Leaf petiole with articulation circled 3. Flower (S.E.M.) 4. Adult leaves 5. Fruits 6. Stand, Washpool State Forest, north-west of Grafton, N.S.W. 7. Foveola (S.E.M.) 8. Seedling with cotyledons 9. Tree, Cangai State Forest near Grafton, N.S.W. 10. Buttress, illustrating the convex outline 11. Adult leaf nervation

Leatherwood

Eucryphia lucida (Labill.) Baill.

Leatherwood may grow to a tall tree some 30 m in height but is more commonly a medium-sized tree of 10–15 m with a diameter of 0.5–0.6 m, or at times only a tall shrub, particularly in the understorey of wet sclerophyll forest. It usually has a deep, compact crown and when in flower is quite showy.

This species is endemic to Tasmania. It is fairly common in the wetter western region, from the Catamaran River in the south to the Arthur River in the north-west with small occurrences on South Bruny Island and Mt Wellington.

Leatherwood occurs on a fairly wide range of topography. It is generally found on soils of intermediate to low fertility, including deep clays to shallow wet peaty soils overlying quartzite or schist.

This tree occurs in cool temperate rainforests (nanophyll moss forests) with myrtle beech (*Nothofagus cunninghamii*), southern sassafras (*Atherosperma moschatum*) and blackwood (*Acacia melanoxylon*). It commonly occurs also in the understorey of mixed forests, which include tall eucalypts such as messmate (*E. obliqua*), alpine ash (*E. delegatensis*) or Smithton peppermint (*E. nitida*). It regenerates freely on disturbed sites.

This is the premier tree species for honey production in Tasmania. It flowers over a long period and produces a pale, scented honey, which candies quickly.

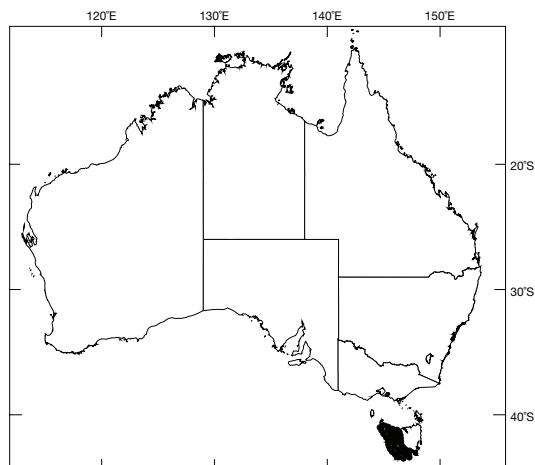
Related species: *Eucryphia* is a genus with 8 species, 3 of which occur in Chile. Floyd (1989) suggests these species have distributions that show some similarity with the ancient, relictual genus *Nothofagus*. Of the Australian *Eucryphia* species *E. milliganii* is a shrub, which occurs at generally higher altitudes in Tasmania, and *E. moorei* (pinkwood) is a graceful tree which grows in temperate rainforests (microphyll fern forest) on the south coast of New South Wales and an adjacent area in Victoria. Forster and Hyland (1997) described a shrubby species, *E. wilkiei* from Mt Bellenden Ker in northern Queensland and *E. jinksii* from southern Queensland.

Publication: *Hist. Plantae* 1, 402 (1867–69). Type: Tasmania, J.J. Labillardière.

Names: Botanical—*Eucryphia*, from the Greek *eu* (well, thoroughly), plus *kryphios* (hidden), alluding to the sepals which are joined at the tips to form a protective cap to the buds; *lucida*, from the Latin *lucidus* (shiny, clear), apparently in allusion to the shiny leaves. Common—probably in reference to the toughness of the timber.

Bark: Dark green to grey-brown, smooth, often has lichens.

Leaves: Cotyledons—shortly petiolate, elliptical, 0.4–0.5 × 0.2–0.25 cm, slightly hairy with small interpetiolar stipules. Seedling—opposite, petioles about 0.1–0.5 cm long, oblong about 0.5–3 × 0.3–1 cm, first 5 leaf pairs with up to 5 teeth at leaf apices, green above paler beneath; interpetiolar stipules, triangular, about 0.1 × 0.2 cm, adnate to stem with only tips free; brown hairs covering stem and leaves. Adult—opposite, simple, shortly petiolate, oblong with a rounded point, 2.5–4.5 × 1.5–2 cm, rather stiff with a dark glossy green



upper surface and pale undersurface; stipules interpetiolar; the young leaves and buds are covered by a clear orange or brownish gum.

Inflorescences: Flowers are borne singly in the axils of upper leaves on pedicels about 1 cm long. Sepals are united to form an operculum, which is shed as the petals expand. Petals 4, white (rarely pink), free, spreading widely, about 1.8 cm in diameter. Stamens numerous, white or cream with red anthers. The 5–7 carpels are joined but the styles are free.

Fruits: Woody or leathery capsules opening into boat-shaped, beaked valves; seeds numerous, winged.

Wood: Sapwood not susceptible to *Lyctus* attack; heartwood pink to brown, with a straight grain and fine uniform texture; growth rings visible but not conspicuous and there may be numerous small knots; pores minute, very numerous, scattered; medium density 635–845 kg m⁻³. The timber is of medium strength that seasons well without distortion or checking. The wood is tough, has good working properties, and glues, nails, bends, turns and polishes well. Availability is limited and only in small sizes.

Climate: Altitudinal range: near sea level to 800 m; Hottest/coldest month: 20–22°C/2–5°C; Frost incidence: moderate to high (upland sites receive 20–50 per year with occasional light snowfalls); Rainfall: 1000–2000 mm per year, uniform.

Distinctive features: Showy flowers and simple, oblong, opposite leaves with gum-covered leaf buds.



Eucryphia lucida 1. Pair of adult leaves 2. Fruiting branch 3. Fruits 4. Flowers 5. Tree, near Smithton, Tas.
6. Seedling 7. Bark

Black Bean Moreton Bay Chestnut

Castanospermum australe A. Cunn. ex Mudie

Black bean is a tall tree up to 40 m in height and with stem diameters to 1.2 m. The stem is not prominently buttressed while the crown is very dense, consisting of abundant dark green glossy foliage. The species is most attractive at flowering time with sprays of orange-red, pea-shaped flowers. The large pendant, cylindrical, bean-like fruits are also conspicuous in the crown.

This species occurs from near Lismore, New South Wales, to Iron Range, Cape York Peninsula, in northern Queensland. It also extends to New Caledonia and the New Hebrides. Black bean is present in the Bellinger and Orara Valleys, New South Wales, but it is not certain that these are natural stands (A.G. Floyd, pers. comm.). It extends inland to the Bunya Mountains in southern Queensland.

The species is common along the banks of streams and rivers in rather sheltered sites or sometimes on terraces upslope from river banks. Soils are river alluvia or deep loams on basalt.

Black bean typically occurs in gallery-type rainforests. These include subtropical and tropical rainforests. The species is often dominant in riverine rainforests. Common associates include weeping satinash (*Waterhousea floribunda*), silky oak (*Grevillea robusta*), brown pine (*Podocarpus elatus*), white handlewood (*Streblus brunonianus*) and various *Ficus* spp. In northern Queensland common associates include blush walnut (*Beilschmiedia obtusifolia*), northern laurel (*Cryptocarya hypospodia*), cheesewood (*Nauclea orientalis*) and creek satinash (*Syzygium australe*).

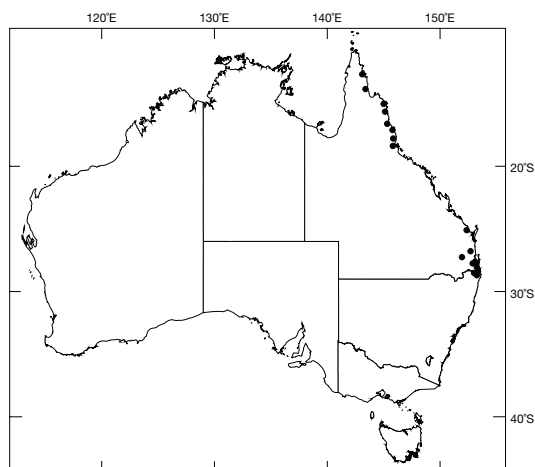
Related species: Black bean is the sole species of this genus.

Publication: *Pict. Australia* 149 (1829). Lectotype: Morton Bay, Queensland, A. Cunningham s.n. *vide* D.J. Mabberley, *Newslett. Austral. Syst. Bot. Soc.* 70, 15 (1992).

Names: Botanical—*Castanospermum*, from the Latin *castanea* (a chestnut), plus Greek *spermum* (seeded), alluding to the fact that the seed is similar in colour and shape to that of the Spanish chestnut (*Castanea sativa* Mill.); *australe*, from the Latin *australis* (southern). Common—refers to the timber colour (black) and the fruit shape (bean-like).

Bark: Grey to brown, slightly rough with very small pustules; outer blaze cream and granular in texture, inner blaze bright yellow with orange vertical stripes. The outer cut blaze has an odour like that of cucumber or pumpkin.

Leaves: Cotyledons—cryptocotylar, 2 large hemispherical cotyledons. Seedling—alternate, petiole bases enlarged near the stem, imparipinnate with compound leaves 10–12 cm long; individual leaflets glossy green, opposite to subopposite, 4–5 pairs, more or less in one plane, lanceolate to slightly ovate, about 5 × 1.5 cm; stem green with brownish white lenticels. Adult—alternate, imparipinnate, 20–35 cm long, about 8–17 mostly alternate leaflets with margins entire; petiolules 0.4–0.7 cm long; narrow elliptical or oval, often unequal-sided at base, obtuse, about 8–17 × 3–6 cm, upper surface glossy green, discolorous; midrib, lateral veins (6–14 pairs) and net veins visible both surfaces.



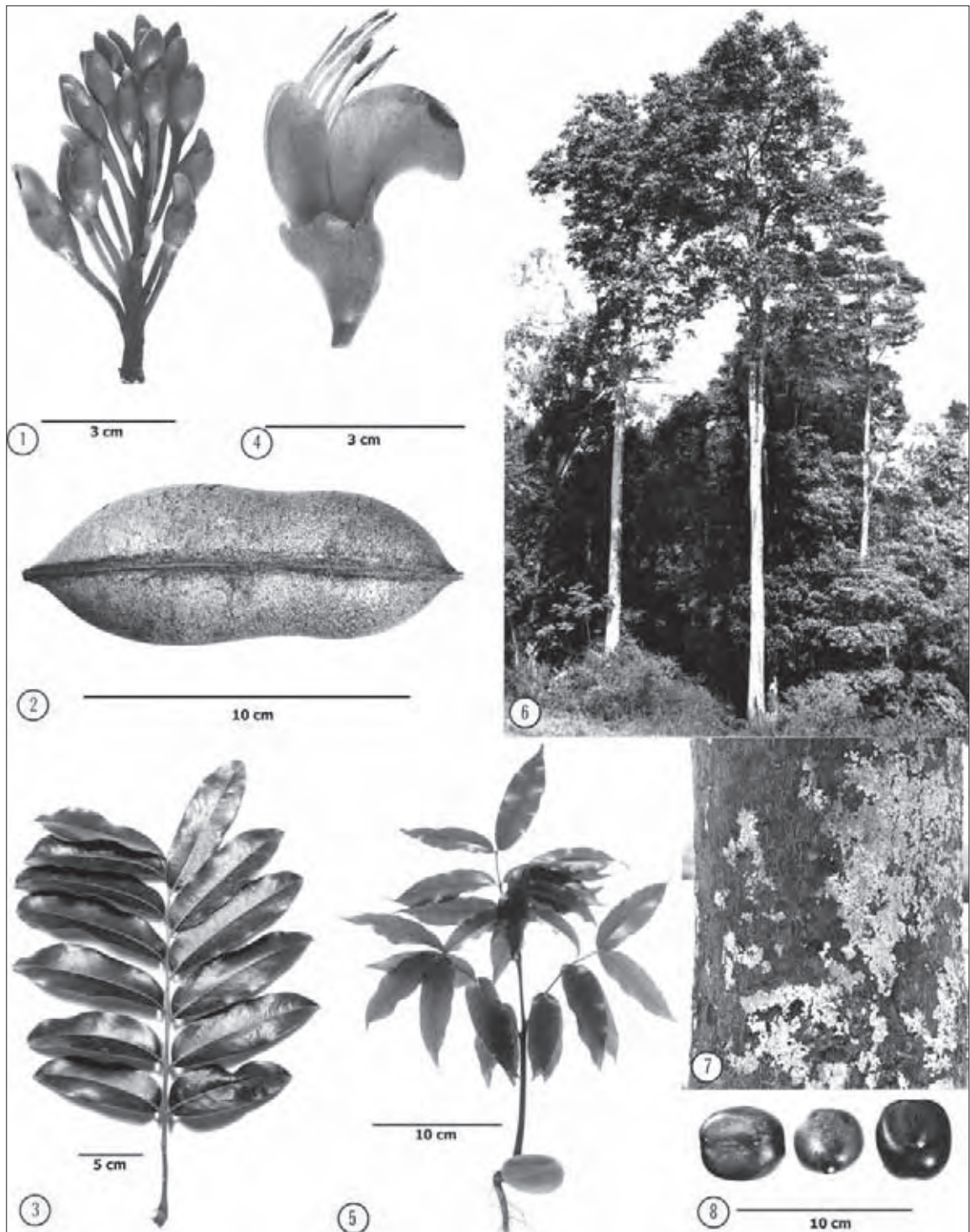
Inflorescences: Racemes up to 15 cm long, pedicels slender and about 2.5 cm long, flowers 4–5 cm long and very attractive. Usually cauline or at least produced on twigs below the leaves. Calyx waxy-yellow, bell-shaped up to 2 × 1.5 cm and 5-lobed at the apex, sparsely covered with small brown hairs. Petals coriaceous, changing from greenish yellow to deep orange, the largest (standard) about 3–4 × 3 cm and 2-lobed at the apex. Stamens yellow, 8–10, all free, incurved, about 4–5 cm long, alternately long and short. Anthers about 0.4 × 0.15 cm and can dehisce in the bud stage. Ovary on a stalk about 1.5–2 cm long, 1-celled, ovules about 3–4. Style 1–2 cm long, glabrous; stigma small, terminal. Flowers Oct.–Nov.

Fruits: Large, woody, pendant cylindrical legumes about 15–25 × 4–5 cm, 2-valved, slightly falcate, with 3–5 cells separated by a spongy substance, containing 3–5 round or compressed, large, brown-coated seeds about 3–5 cm diameter. Mature Feb.–Apr.

Wood: Sapwood varies from white to yellow, susceptible to *Lyctus* attack; heartwood dark chocolate-brown to almost black (an unusual colour in Australian rainforest trees), straight grained but sometimes interlocked, coarse-textured, durable when exposed to weather and in the ground, density about 565–810 kg m⁻³. The wood of black bean is highly figured and is one of Australia's most attractive cabinet timbers and is highly prized for carved and inlay work, furniture, panelling, plywood and joinery. It is suitable for the production of sliced veneers with highly attractive figure.

Climate: Altitudinal range: 50–1000 m; Hottest/coldest month: 30–35°C/10–20°C; Frost incidence: mainly low but ranging to moderate at upland sites in the south of its range; Rainfall: 1000–3800 mm per year, summer max.

Distinctive features: Large tree, stem not buttressed, glossy dark green pinnate leaves, large cylindrical legumes 10–25 cm long, and large, attractive, orange, pea-shaped flowers.



Castanospermum australe 1. Inflorescence at bud stage 2. Fruit 3. Adult leaves 4. Flower 5. Seedling 6. Tree, near Wiangaree, N.S.W. 7. Bark 8. Seeds

Grey Corkwood Corkwood, Batwing Coral Tree

Erythrina vespertilio Benth. in T. Mitch.

Grey corkwood is usually a small to medium-sized tree attaining a height of 15 m and a diameter of 0.3 m. Occasionally large specimens reach 30 m tall and 0.8 m diameter. The stem is not buttressed. The leaves resemble batwings and make this species a conspicuous tree in northern Australia. The species is deciduous during the dry season and often flowers while leafless.

This species has a wide distribution across northern Australia occurring north and south of the Tropic of Capricorn. It is widespread in coastal and inland Queensland, the Northern Territory and the Kimberley and Hamersley regions of Western Australia and extends to northern New South Wales. Reported from near Oodnadatta and Cleland Hill in northern South Australia but not located recently at these sites. Some offshore occurrences include Thursday Island, Queensland, and Dolphin and Barrow Islands, Western Australia.

Soils vary considerably, as might be expected with a species occurring from the western to the eastern coasts of Australia.

Grey corkwood occurs in a wide range of vegetation types from drier rainforest to desert, and is associated with a diverse range of species.

Related species: There are only 2 or 3 other species of *Erythrina* native to Australia. *E. variegata*, is a tree of the tropical seashores; *E. insularis* is probably conspecific with *E. vespertilio*; and there is an undescribed species.

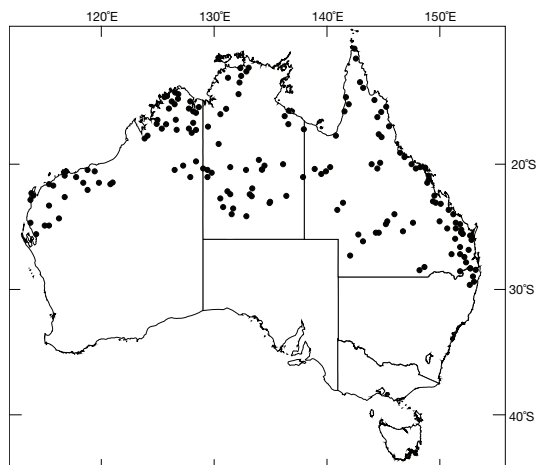
Publication: *J. Exped. Trop. Australia* 218 (1848). Type: Maranoa?, Queensland, T. Mitchell.

Names: Botanical—*Erythrina*, from the Greek *erythros* (red), plus *inos*, a suffix denoting colour, alluding to the red colour of the flower; *vespertilio*, from the Latin *vespertilio* (a bat), alluding to the bat-like shape of the leaflets of some forms of this species. Common—alludes to the lightweight greyish timber.

Bark: Pale, corky, fissured and sometimes with a scattering of short spines.

Leaves: Cotyledons—cryptocotylar. Seedling—first 2–3 pairs opposite, unifoliate; petioles about 2 cm long; deltoid, about 3–5 × 4–8 cm, with 2 apiculate stipules about 0.3 × 0.1 cm at the base of the petiole, and also 2 stipules at the base of the leaf joint. Leaves at node 4–8, on petioles about 3–5 cm long, are alternate, imparipinnate, consisting of 3 deltoid leaflets with the middle leaflet slightly larger than the 2 side ones, about 4.5 × 5.5 cm, petiolules 0.5–2 cm long. Stem, petioles and leaf edges have sharp thorns up to 0.1–0.2 cm long. The root near ground level is quite enlarged. There is considerable variation in leaflet shape depending on locality. Adult—spirally arranged on twigs, which are often spiny, pinnate with 3 leaflets, petiolules 0.4–0.6 cm long. Leaflets very variable, three-lobed on trees in the wetter areas and about 10 × 12 cm but two-lobed and broadly V-shaped on trees in dry areas, each lobe about 3–4 × 0.5 cm. Lateral veins 1–7.

Inflorescences: Terminal or axillary racemes up to 25 cm long, flowers large, pedicels slender, about 1–1.5 cm long. Calyx cylindrical about 1.5 cm long, splitting along one side.



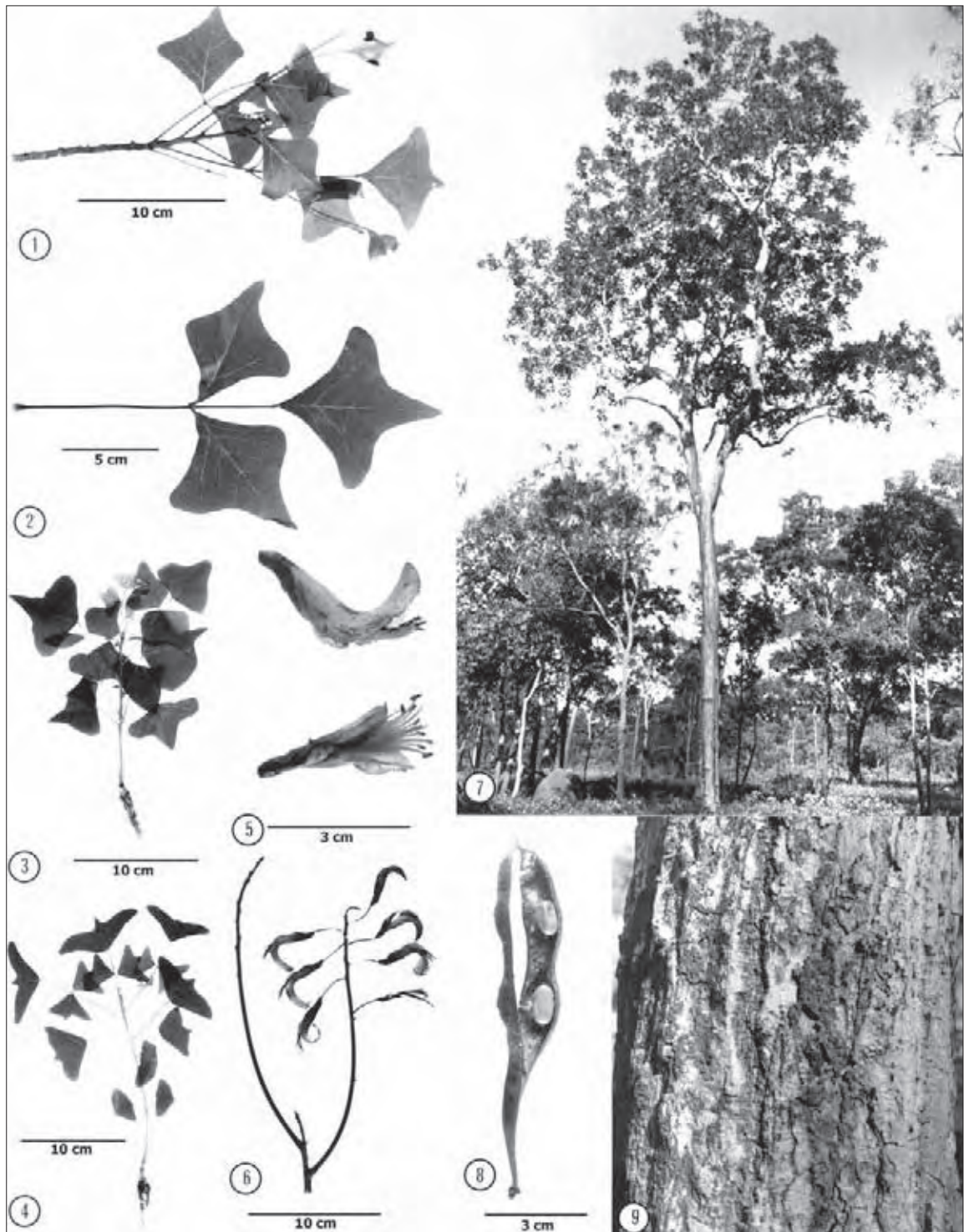
Petals red or orange, variable in size, the largest petal (standard) about 3 × 1.5 cm, marked by numerous longitudinal veins, other petals much smaller (about 1 cm long). Stamens 10, filaments about 3 cm long, 9 filaments fused for the greater part of their length and 1 filament free. Anthers versatile, about 0.3 × 0.1 cm. Ovary stalked, 1-celled, with 6 ovules. Style about 1.5 cm long, approximately the length of the stamens, base covered in a mass of brown hairs. Flowers Jul.–Nov.

Fruits: Legumes about 12 × 1–1.5 cm, seeds 4–6, orange or red, reniform about 1.2 × 0.6 cm.

Wood: Sapwood susceptible to *Lyctus* attack; heartwood pale brown with silky lustre and pronounced figure, soft, light, neither strong nor durable, density 165–200 kg m⁻³ makes it one of the lightest Australian hardwoods. The species is of little commercial value, but the wood is light enough to serve as a substitute for cork, and has been used for insulating boards, surfboards and floats. Its leaves and flowers make it an attractive ornamental.

Climate: Altitudinal range: near sea level to 800 m; Hottest/coldest month: 30–39°C/5–20°C; Frost incidence: variable (frost-free coastal areas to inland areas which receive about 10–15 frosts per year); Rainfall: 150–1700 mm per year, mainly summer max.

Distinctive features: Corky bark, pinnate leaves with 3 batwing-shaped leaflets, red flowers, legumes and red or orange seeds.



Erythrina vespertilio 1. Adult leaves and branches 2. Adult leaf with leaflets 3. Seedling, elongated leaflet form 4. Seedling, short leaflet form 5. Flowers 6. Inflorescence 7. Tree, northern Qld 8. Fruit dehiscing and exposing seeds 9. Bark

Myrtle Beech Myrtle (Tas.)

Nothofagus cunninghamii (Hook.) Oerst.

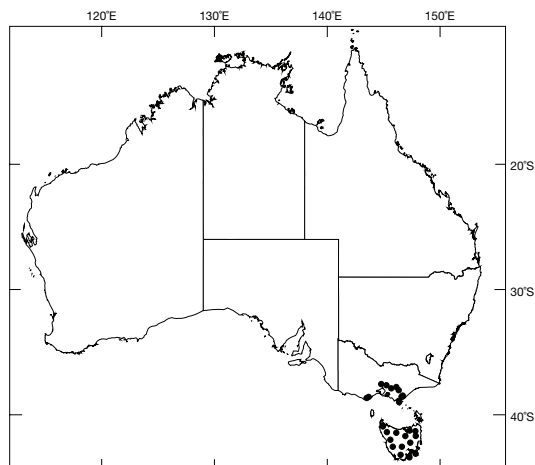
Myrtle beech is a tall to very tall tree attaining 30–40 m in height and 1.5–2.5 m in diameter on optimum sites. It is also common as an understorey tree 6–18 m in height in tall open forests or as a shrub less than 1.5 m tall at high altitudes and on sites exposed to wind. On good sites it is a well-formed tree with a long straight trunk, slight buttresses or basal burls with adventitious shoots at the butt and on the lower part of the trunk, and a dark green, fine-textured crown, which may have a ragged appearance. Multi-stemmed trees are more common in Victoria than in Tasmania.

This species is common in western and north-eastern Tasmania with small areas of occurrence on Tasman Peninsula and South Bruny Island, and extends in Victoria from the Otway Range and Wilsons Promontory to the Federation Range. The most easterly occurrence in Victoria is Bulga National Park.

Myrtle beech occurs on a wide range of topography, from moist sheltered gullies through moderate to steep slopes, to broad ridgetops and plateaux. The only sites in which it does not occur are shallow rocky ridges and periodically waterlogged sites. Soils are derived from a range of parent materials, from shales, arkose, metamorphics and granite to basalt. Best growth is on deep red loams developed from basalt, in north-western Tasmania.

Myrtle beech either grows in pure stands, with the tree fern *Dicksonia antarctica* as the only vascular species in the understorey, or as the major component in cool temperate rainforest (nanophyll moss forest). It is usually associated with southern sassafras (*Atherosperma moschatum*), leatherwood (*Eucryphia lucida*) and the conifers King William pine (*Athrotaxis selaginoides*) and celery top pine (*Phyllocladus aspleniifolius*). With these associates it often forms a dense understorey beneath tall eucalypts, in regions with rainfall of 1100–1600 mm. There is often a tall shrub layer of *Leptospermum* species, *Pittosporum bicolor* and horizontal (*Anodopetalum biglandulosum*). Above about 600 m there is sometimes an overstorey of King William pine, while along streams and on alluvial flats at low altitudes Huon pine (*Lagarostrobos franklinii*) was at one time common (now mostly harvested). Blackwood (*Acacia melanoxylon*) is also common on wetter sites. Above about 900 m myrtle beech is reduced to a shrub, and may be replaced to some extent by tanglefoot beech (*Nothofagus gunnii*). In Victoria it may be associated with tall eucalypts (*E. regnans*, *E. delegatensis*, *E. nitens*), southern sassafras and silver wattle (*Acacia dealbata*).

Myrtle beech is fire-sensitive but regenerates vigorously from seed on disturbed sites. In Victoria the elaborate development of epicormic buds also enables trees to regenerate by coppicing after fire. Trees are subject to attack by pinhole borer (*Platypus subgranosus*), which is a serious insect pest because the holes produced allow



the entry of a pathogenic fungus. This causes widespread mortality especially in disturbed forests, e.g. along roadsides. An obligate parasitic fungus, *Cyttaria gunnii*, often grows on myrtle beech, its fructifications resembling bunches of yellow grapes on the branches, from November to January.

Related species: There is a second species of *Nothofagus* in Tasmania, tanglefoot (*N. gunnii*), which grows mainly at higher altitudes, has larger leaves and is deciduous during winter. It is normally a scrambling shrub. Negrohead beech (*N. moorei*) occurs in northern New South Wales and Queensland and has larger leaves than *N. cunninghamii*.

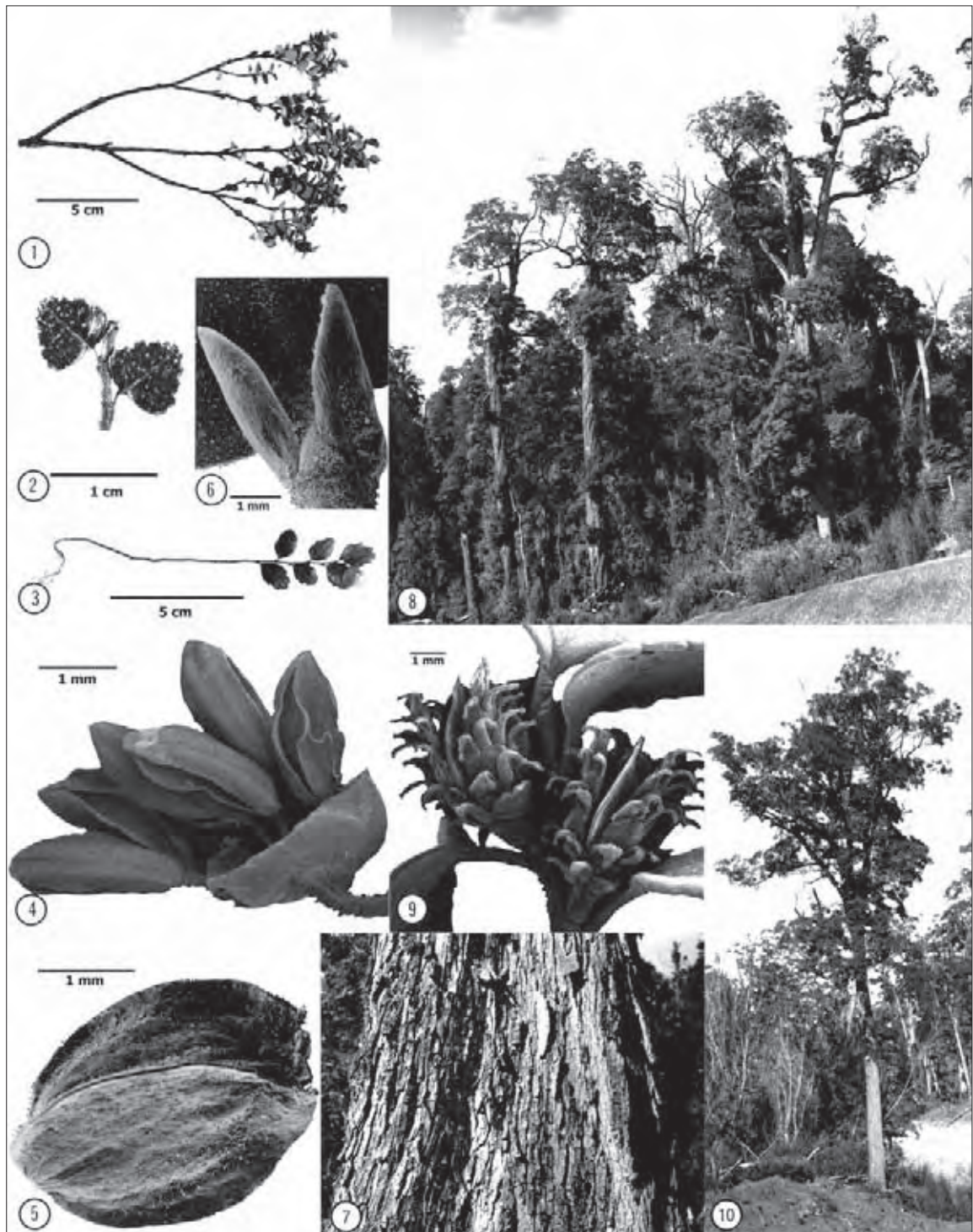
Publication: *Vidensk. Selsk. Skr. Ser. 5*, 9, 355 (1871). Type: syntypes collected in Tasmania at Pine Cove, and Macquarie Harbour, by A. Cunningham; Emu Bay, by J. Backhouse; side of Mt Wellington, by J. Backhouse; western parts of Tasmania, by Dr Milligan and R. Gunn.

Names: Botanical—*Nothofagus*, from the Greek *notho* (false), plus Latin *fagus* (a beech tree), alluding to the fact that it differs from the northern hemisphere beech, *Fagus* spp.; *cunninghamii* honours A. Cunningham (1791–1839), an explorer and botanical collector mainly in eastern Australia. Common—origin of myrtle is unknown.

Bark: Brown, scaly and slightly fibrous.

Leaves: Seedling—alternate, petioles to 0.1–0.2 cm long, ovate, about 0.7–1.5 × 0.4–0.9 cm, crenulate, glossy green above and dull beneath, nervation only slightly visible on both surfaces; stipules about 0.1–0.3 cm long with a broad base tapering into a fine point at the apex. Adult—shade leaves are borne in flattened sprays, and are alternate, shortly petiolate, ovate to almost triangular, 1–1.8 cm × 1–1.5 cm, with a coarsely and bluntly toothed margin, thick, stiff and slightly convex with a dark green shining upper surface marked by translucent glands; sun leaves are smaller (0.6–1.2 × 0.5–1 cm) and are inclined upwards. New leaves in spring are red to bronze-coloured; the narrow membranous stipules fall early.

Inflorescences: Flowers are borne on newly expanded shoots near the ends of the branches, on short lateral shoots and with



Nothofagus cunninghamii 1. Adult leaves on branchlet 2. Pair of adult leaves 3. Seedling 4. Male inflorescence 5. Nut 6. Pair of stipules at the base of a leaf 7. Bark 8. Stand, near the Arthur River, Tas. 9. Female inflorescences 10. Tree, near the Arthur River, Tas.

female flowers above the male. Males—solitary or occasionally in threes, with a short stalk bearing a broadly bell-shaped, 6-lobed perianth about 0.25 cm long containing 8–12 stamens. Females—normally 3 together with an involucre of gland-tipped bracts about 0.15 cm long; there are 3 minute gland-tipped perianth lobes on the angles of the ovary and 3 broad thick blunt stigmas. Flowers in spring.

Fruits: Each fruit has an involucre which separates into 4 valves each about 0.6 cm long and with 4 or 5 rows of curved teeth. Within the involucre are 3 nuts; the two outer nuts have 3 wings and the central nut is flat. Seeds are shed late summer to early autumn.

Wood: Sapwood white; often with a wide, pale-coloured intermediate zone, heartwood, pink to red-brown with straight or slightly interlocked grain, occasionally a wavy figure, fine uniform texture, moderate strength, hard and tough but only moderately durable, density 585–795 kg m⁻³. The wood has visible growth rings and pores which are small,

numerous and scattered. Timber colour is reputedly paler in trees grown on poor soil than on good soil. Seasons and reconditions with difficulty, but works well and has excellent bending qualities. A beautiful furniture and cabinet timber, also used for panelling, parquetry and flooring, veneers, turnery and formerly heels for shoes.

Climate: Altitudinal range: near sea level to 1570 m with best development below about 700 m; Hottest/coldest month: 20–25°C/0–5°C; Frost incidence: low to heavy (snowfalls at higher localities); Rainfall: 1100–2500 mm per year, winter max.

Distinctive features: The small, toothed, shining leaves arranged in fan-like fronds and, on large trees, the dark brown scaly bark, commonly with adventitious shoots, are distinctive in its area of occurrence. The presence of a bright, orange, parasitic fungus ‘myrtle orange’ (*Cyttaria gunnii*) causes woody lumps to form on branches and by association readily aid the observer in distinguishing this species.



The relatively small leaves of myrtle beech (*Nothofagus cunninghamii*), the abundant mosses and epiphytes and an understorey of ferns dominated by the tree fern (*Dicksonia antarctica*), give Australian temperate rainforests a distinctive appearance, Bulga National Park, Victoria (above and below, images: O. Strewe).

Negrohead Beech

Nothofagus moorei (F. Muell.) Krasser

Negrohead beech is a tall tree, growing to 30–40 m in height and 1–1.5 m in diameter, but generally of irregular form, with crooked or leaning trunks and a dense dark green crown, usually with red leaves scattered through it. These are old, senescent leaves but the new foliage in spring is also deep red and twigs have a covering of brown down. The butts of trees are often enlarged, with many small adventitious shoots, and stages of development can be seen extending through the presence of several subsidiary stems around the original one, to circular groups of stems surrounding a gap where the original one has died and rotted away.

This species has a disjunct distribution from Barrington Tops, north-west of Newcastle in New South Wales, to just beyond the McPherson Ranges near the New South Wales–Queensland border (at Mt Mistake).

Negrohead beech typically occurs along creeks and on the upper slopes and ridges of mountains. It sometimes grows in locally sheltered sites, as at Point Lookout where it is protected by an overhanging scarp, or in shallow drainage lines, but in other places, such as Wiangaree, it is found on the crest of the range. Soils vary from deep red loams to poorly developed clay loams with much stone in the profile, on a range of parent materials, from basalts and granodiorites to shales.

This tree is usually a constituent of cool temperate rainforest (nanophyll moss forests) and at times is a very clear dominant. The species may occur in pure stands, or with coachwood (*Ceratopetalum apetalum*), sassafras (*Doryphora sassafras*), mountain quandong (*Elaeocarpus obovatus*) and prickly ash (*Orites excelsa*).

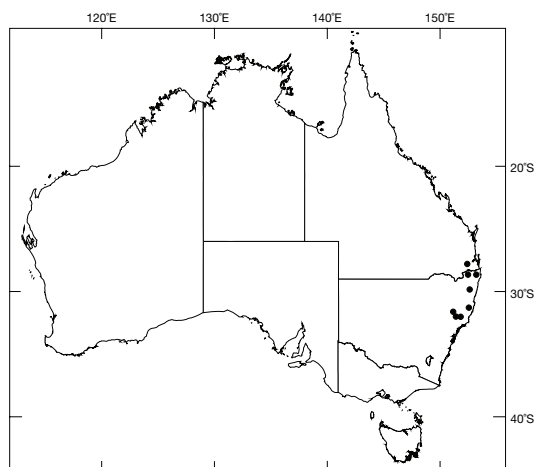
Related species: *Nothofagus* is a southern hemisphere genus with representatives in New Guinea, New Zealand and South America as well as Australia. Of the three Australian species, *N. cunninghamii* occurs in Tasmania and Victoria; it has much smaller leaves than *N. moorei*. *N. gunnii* is deciduous in winter and is restricted to Tasmania where it occurs as a scrambling shrub or small tree.

Publication: *Ann. K. K. Naturhistorischen Hofmuseums Vienna* 11, 161 (1896). Type: syntypes from near the Belling River, Bielsdown Creek and Macleay River, New South Wales, C. Moore.

Names: Botanical—*Nothofagus*, see notes under *Nothofagus cunninghamii*, *moorei* honours C. Moore (1820–1905), a former Director of the Botanic Gardens, Sydney, New South Wales. Common—believed to allude to the rich dark green colour of the foliage.

Bark: Thick, dark brown to reddish brown and scaly. The cut blaze is red grading to pink.

Leaves: Seedling—alternate, petioles to 0.3 cm long, ovate-elliptical, about 0.2–0.8 × 0.1–0.3 cm, margin serrulate. Adult—alternate and distichous, petiolate, ovate, about 4–6 × 3–4 cm, acute; margins are finely toothed, both surfaces are smooth and dark green, and the leaves are rigid and brittle; the narrow stipules at the base of the short leaf stalk are shed soon after leaf maturity.



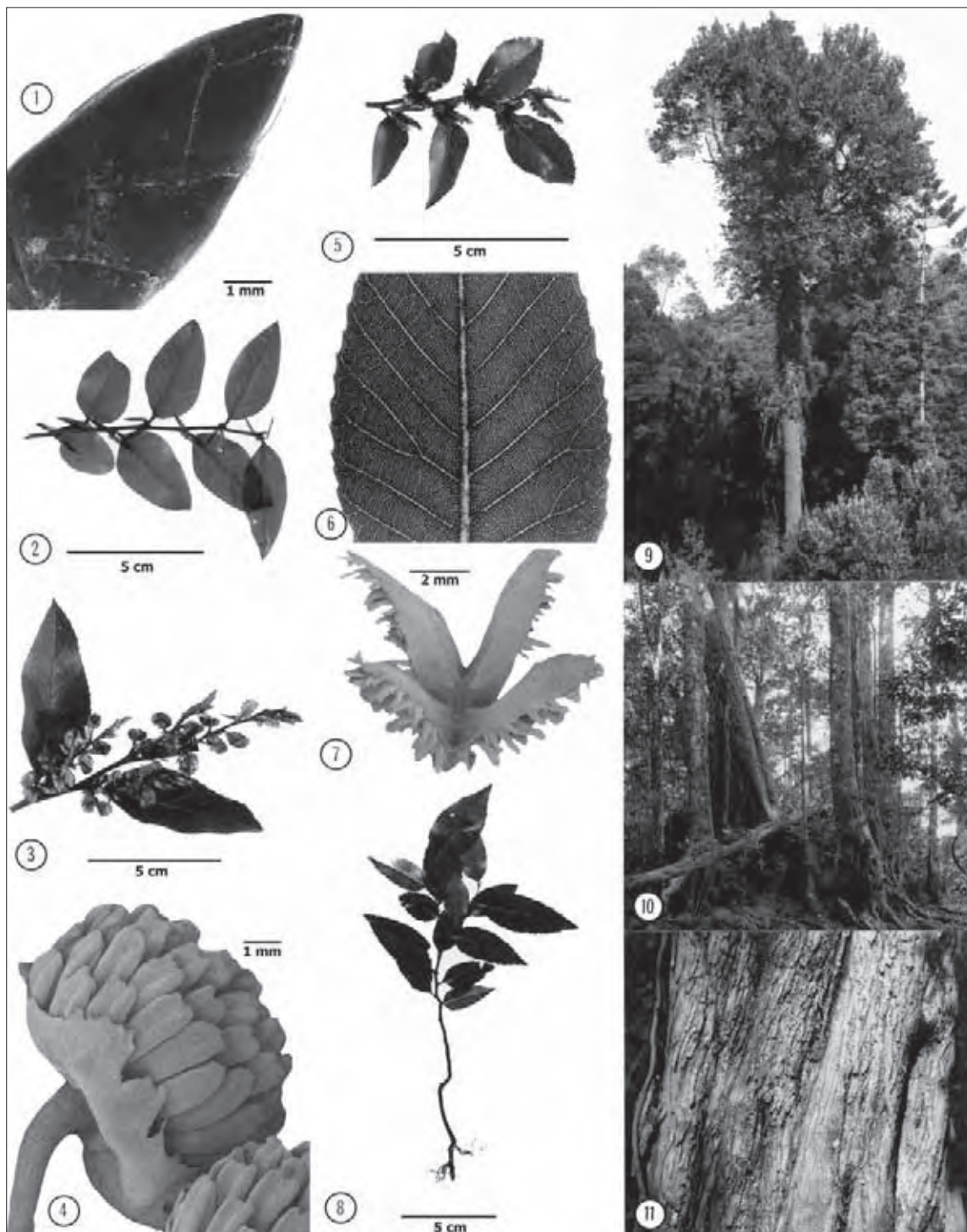
Inflorescences: Separate male and female flowers are borne on new shoots on the same tree. Males—in rounded or flattened catkins about 1 cm in diameter, in the forks of the lower leaves; each catkin is made up of a cup-shaped involucre, 8–12 lobed, enclosing 15 or more stamens (up to 32) 0.3–0.4 cm long. Female—also borne in the forks of the upper leaves; consist of numerous small bracts united to form an ovoid unit about 0.5 cm long, containing 3 flowers.

Fruits: About 0.8 cm long and split into 4 prickly valves, enclosing 3 nuts. The 2 outer nuts have 3 wings and the central nut is flat.

Wood: Similar to that of myrtle beech (*Nothofagus cunninghamii*).

Climate: Altitudinal range: 550–1500 m, but mostly over 800 m; Hottest/coldest month: 20°C/3°C; Frost incidence: moderate (snowfalls occasional in southern localities); Rainfall: 1500 mm per year, summer max., with the driest month getting about 60 mm, augmented by mountain mists.

Distinctive features: Negrohead beech is a montane species with scaly dark brown bark, alternate toothed leaves and fruit consisting of a 4-valved involucre containing 3 nuts.



Nothofagus moorei 1. Resting bud 2. Branch showing stipules 3. Male inflorescences on branchlet 4. Male flower (S.E.M.) 5. Branch with opened cupules 6. Leaf nervation 7. Open fruit 8. Seedling 9. Tree, near Cascade, N.S.W. 10. Stand, McPherson Range, N.S.W. 11. Bark

Rose Maple Pigeonberry Ash, Rose Walnut, Southern Maple

Cryptocarya erythroxylon Maiden & Betche ex Maiden

Rose maple is a tall symmetrical tree attaining a height of 35 m with a stem diameter of 1.25 m. The trunk is usually cylindrical and often buttressed at the base, but the buttresses rarely extend far up the trunk. The white to grey trunk of this species is conspicuous in the forests where it occurs.

This species occurs along the eastern coast of Australia from the Upper Williams River area, near Barrington Tops, New South Wales, to the MacPherson Range in southern Queensland. It is more commonly encountered in the border districts between Queensland and New South Wales.

Rose maple grows on the sides of mountains and on plateaux in well-drained situations. Soils are mainly clay loams derived from basaltic parent materials. The species may occasionally grow on more enriched deep soils that have increasing clay with depth.

Rose maple occurs in warm temperate (simple notophyll vine forests) to subtropical rainforests (complex notophyll vine forests). The main associated species are negrohead beech (*Nothofagus moorei*), small-leaved laurel (*Cryptocarya foveolata*), prickly ash (*Orites excelsa*), silver sycamore (*Cryptocarya glaucescens*) and doughwood (*Melicope octandra*) particularly in Wiangaree State Forest, rosewood (*Dysoxylum fraserianum*), purple cherry (*Syzygium crebrinerve*) and giant stinging tree (*Dendrocnide excelsa*).

Related species: There are about 40 species of *Cryptocarya* in Australia and about 15 species occur in New South Wales. *Cryptocarya erythroxylon* is most closely allied to *C. glaucescens* but differs in that the fruits of the latter are depressed and the leaves are less glaucous on the undersides, and to *C. microneura* in which the leaves are green on both sides.

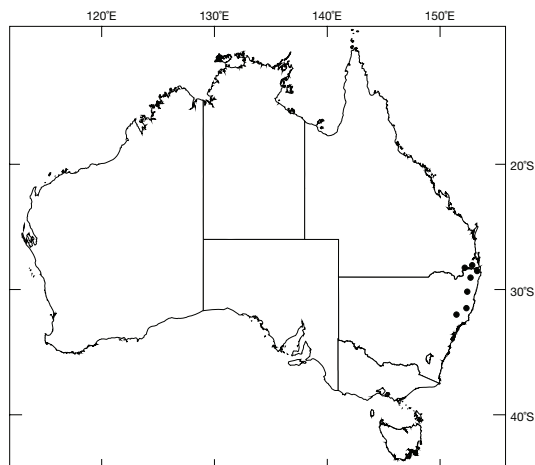
Publication: *Forest. Fl. N.S.W.* 3, 111 (1907). Type: Acacia Creek (MacPherson Range), New South Wales, W. Dunn.

Names: Botanical—*Cryptocarya*, from the Greek *kruptos* (concealed, hidden), plus *karyon* (a nut), which alludes to the hard seed being enclosed in a fleshy perianth; *erythroxylon*, from the Greek *erythros* (red), plus *xylon* (wood), alluding to the pink timber of the species. Common—rose, after the colour of the heartwood, and maple in reference to the superficial resemblance of the wood to that of maple (*Acer* spp.).

Bark: Grey to whitish, corky in texture, when crushed or cut has a fragrant odour. The cut blaze is pink and the wood has a fruity smell.

Leaves: Cotyledons—cryptocotylar. Seedlings—sub-opposite, simple, entire, ovate-elliptical, acuminate. Adult—alternate, petioles to 1–1.5 cm long, simple, margins entire, elliptical, 5–13 × 2.5–3.5 cm, tapering to a blunt point at the apex, upper surface smooth, green, lower surface smooth and glaucous and clothed in a glaucous waxy process; nervation prominent with net veins finely reticulate, more prominent on the underside.

Inflorescences: Terminal to subterminal panicles. Pedicels of individual flowers short, flowers about 0.2 cm long. Perianth



divided to the middle into 6 minutely hairy lobes, the lower individual part of the perianth narrower than the upper lobed part. Stamens in 2 rows with an outer row of 6 stamens and the inner row of 3 perfect stamens alternating with 3 staminodes. Each perfect stamen has 2 glands at its base, 1 on each side. The ovary is enclosed by the base of the perianth and the ovary tapers at its apex into the style. Flowers Nov.–Dec.

Fruits: Drupes, egg-shaped to pear-shaped, about 1.3 cm in diameter, slightly longer than broad, crowned by the remains of the perianth lobes, and each containing a single seed.

Wood: Sapwood paler and readily distinguishable from heartwood, susceptible to *Lyctus* attack; heartwood pale pinkish brown that weathers orangish, grain sometimes interlocked, figure on backcut face, density about 575–780 kg m⁻³. The wood is easy to work, has a distinctive odour resembling crushed celery, and is suitable for furniture, plywood and joinery.

Climate: Altitudinal range: 100–700 m; Hottest/coldest month: 26–30°C/2–8°C; Frost incidence: mainly low but ranging to moderate at upland sites; Rainfall: 1000–1700 mm per year, summer max.

Distinctive features: A rainforest tree with white to grey bark, which gives off a fragrant odour when freshly cut, and has a glaucous waxy underside to the leaves. The wax melts when a lighted match is applied to the upper surface.



Cryptocarya erythroxylon 1. Adult leaves 2. Fruits on branch 3. A fruit 4. Tree, Wiangaree State Forest, near Kyogle, N.S.W. 5. Bark with a damaged section on the L.H.S. 6. Seedling, from field, Wiangaree State Forest, near Kyogle, N.S.W.

Queensland Walnut Black Walnut, Walnut

Endiandra palmerstonii (F.M. Bailey) C.T. White & W.D. Francis

Queensland walnut is a medium-sized to tall, well-formed tree attaining a height of 40 m and a diameter of 2.2 m. The stem is usually buttressed but the buttresses do not extend far up the trunk.

This species has a restricted distribution in northern Queensland between Cardwell and Cairns.

Soils are usually deep loams on granite or basalt, with the species reaching its best development on the latter.

Queensland walnut grows in a variety of rainforest types and is associated with a large number of tree species.

Related species: There are about 35 species of *Endiandra* in Australia.

Publication: *Queensland Bot. Bull.* 22, 36 (1920). Type: Russell River, northern Queensland, C. Palmerston.

Names: Botanical—*Endiandra*, from the Greek *endon* (within, inside), plus *andros* (a man), alluding to the stamens being in the inner series of perianth parts; *palmerstonii*, honours Christoforo Palmerston Carandini alias Christie Palmerston (c. 1850–1893), prospector, explorer, adventurer and scourge of Chinese miners. Common—alludes to the superficial resemblance of the timber to that of the northern hemisphere walnuts (*Juglans* spp.).

Bark: Nondescript to somewhat flaky in texture. The outer blaze is pink or red, and is usually aromatic.

Leaves: Cotyledons—hemispherical, cryptocotylar.

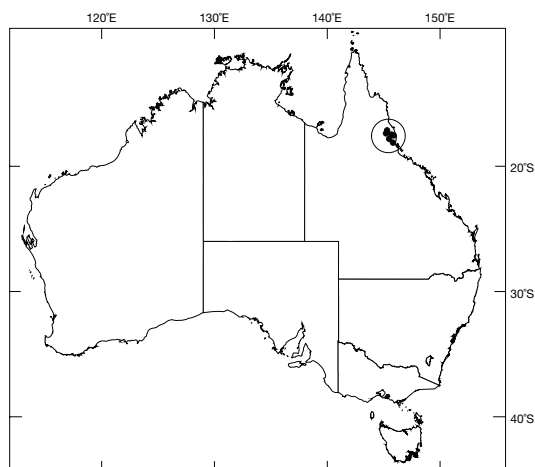
Seedling—cataphylls about 7–10, spirally arranged, true leaves spirally arranged, petioles about 0.5–1 cm long, simple, entire, elliptical-lanceolate, acute-acuminate, slightly oblique at base, 7–17 × 2–4.5 cm, scattered hairs on both surfaces, dark green above, faintly glaucous beneath; nervation reticulate, visible both surfaces. Adult—spirally arranged, petioles about 0.7–2.5 cm long, simple, broad-lanceolate, 8–17 × 3–7.5 cm, entire; lateral veins about 6–9 pairs.

Inflorescences: Terminal and in the upper axils, panicle. Flower buds globular. Flowers cream, very small, less than 0.2 cm diameter at anthesis. Sepals 6, stamens 3, extrorse, sessile. Ovary 1-celled, containing 1 ovule. Style and stigma small and inconspicuous. Flowers Nov.–Feb.

Fruits: Drupes, each about 6 × 5 cm, greenish yellow at maturity, pericarp leathery, often slightly ribbed longitudinally. Seed solitary, globular, about 3–4 cm diameter. Seedcoat thick and nut-like.

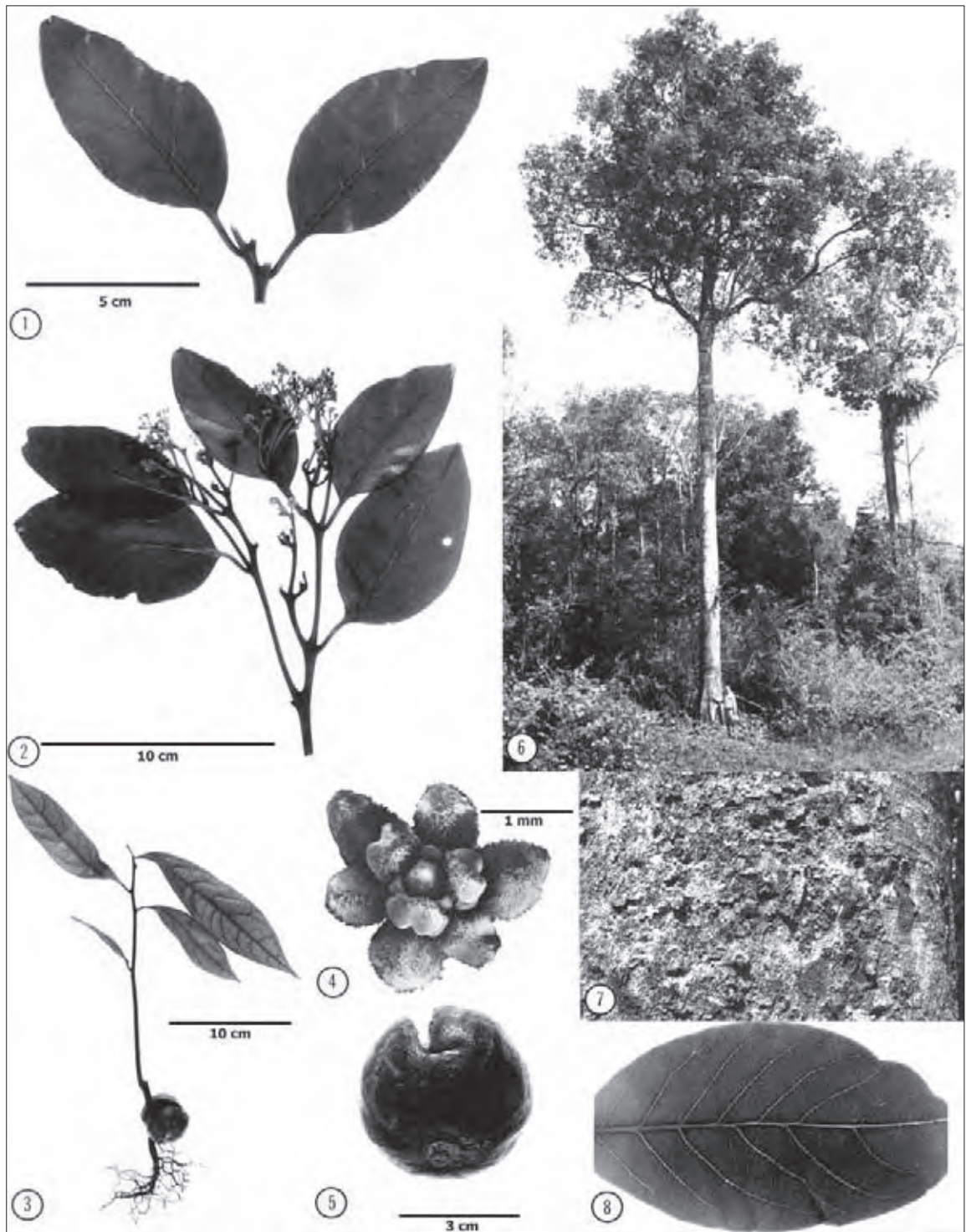
Wood: Sapwood susceptible to *Lyctus* attack and rather wide (10 cm or more); heartwood streaky, black, brown or chocolate, often with paler bands interspersed, firm and hard to cut, very finely textured but abrasive to machine tools, density 580–775 kg m⁻³. Although highly abrasive due to silica content, it is very suitable for the production of sliced veneer and high quality cabinetwork, taking a high polish; used in guitars as ‘tonewood’ and an excellent substitute for true walnut.

Climate: Altitudinal range: near sea level to 1200 m; Hottest/coldest month: 29–30°C/10–15°C; Frost incidence: mainly low



but moderate at upland sites; Rainfall: 1250–3800 mm per year, summer max.

Distinctive features: Pink or red blaze, small flowers with 3 anthers, large fruit with hard-shelled seed; dark heartwood.



Endiandra palmerstonii 1. Adult leaves 2. Adult leaves and inflorescences 3. Seedling 4. Flower (S.E.M.) 5. Fruit 6. Tree, Gadgarra State Forest Reserve, near Atherton, Qld 7. Bark 8. Adult leaf nervation

Rosewood *Rose Mahogany*

Dysoxylum fraserianum (A. Juss.) Benth.

Rosewood is a tall to very tall tree attaining a height of 40 m and a stem diameter of 1.5 m. The largest tree in New South Wales is 56.9 m tall and 3.55 m in diameter. The stem is often somewhat flanged at the base but is not prominently buttressed. The crown is usually dense, rounded, dark green and shiny.

This species is distributed discontinuously along the eastern coast of Australia from near Wyong, New South Wales, to the border area between New South Wales and Queensland. The main occurrences in New South Wales are in the rainforests of the Dorrigo Plateau and the Richmond and MacPherson Ranges. The main occurrences in Queensland are in the ranges around Killarney, Tambourine Mountain and the Mistake Ranges and it extends north to the Bundaberg region.

Typical sites for rosewood are flat to moderate slopes on the sides of mountain ranges. The species typically prefers deep soils of high fertility derived from basalt such as in the Dorrigo and Wiangaree areas of New South Wales.

The species usually occurs in subtropical rainforests (complex notophyll vine forests). Common associates include booyong (*Argyrodendron* spp.), rose maple (*Cryptocarya erythroxylon*), prickly ash (*Orites excelsa*), yellow carabeen (*Sloanea woollsii*), tamarind (*Diploglottis cunninghamii*) and red carabeen (*Geissois benthamiana*). Doughwood (*Melicope octandra*) is also a common associate.

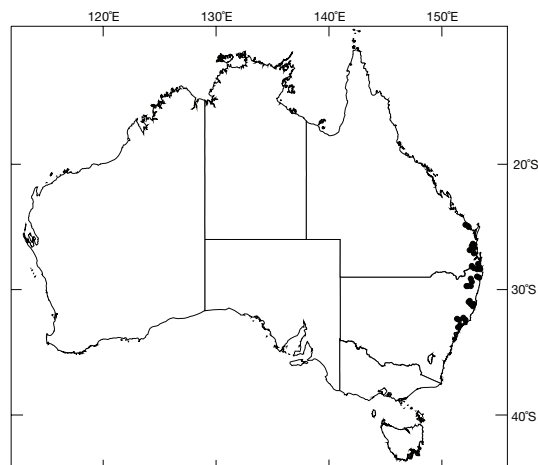
Related species: There are 14 other species of *Dysoxylum* in mainland Australia (Mabberley 2004). Of these species only *D. mollissimum* subsp. *molle* and *D. rufum* occur in New South Wales, extending from about the vicinity of Bellingen, New South Wales, to Cairns, Queensland.

Publication: *Fl. Austral.* 1, 381 (1863). Type: Hastings River, New South Wales, C. Fraser.

Names: Botanical—*Dysoxylum*, from the Greek *dys* (ill-smelling), plus *xylon* (wood); *fraserianum*, honours C. Fraser (1788?–1831), the first colonial botanist of New South Wales. Common—probably alludes to the odour of freshly cut bark which has a strong fragrance of roses.

Bark: Light brown and scaly. Underbark reddish brown with irregular lighter coloured lines.

Leaves: Cotyledons—cryptocotylar. Seedling—alternate, petioles to 1.5–5 cm long with hairy enlarged bases, imparipinnate, 6–16 cm long; leaves compound, consisting of 2–3 opposite pairs of sessile to shortly petiolate leaflets, ovate to obovate, 3–7 × 1.5–3.5 cm, terminal one larger, 4.5–11 × 2–5 cm; all leaflets glabrous, dark shiny green above and paler beneath, margins entire with a few poorly developed domatia on undersurface; nervation reticulate, with main lateral veins linking in large loops near margin. Adult—alternate, petioles about 5–7 cm long, pinnate, consisting of 5–10 leaflets, each leaflet with the appearance of an ordinary leaf, entire, petiolules 0.3–0.6 cm long, oblong-lanceolate or elliptical, apex acuminate, narrowed and equal at base, 8–16 × 4–7 cm, midrib and lateral nerves prominent on both



surfaces; conspicuously raised glands (domatia) in axils of primary and secondary veins or less often in axils of secondary and tertiary veins with hairs at entrance to glands; immature leaf is finely hairy.

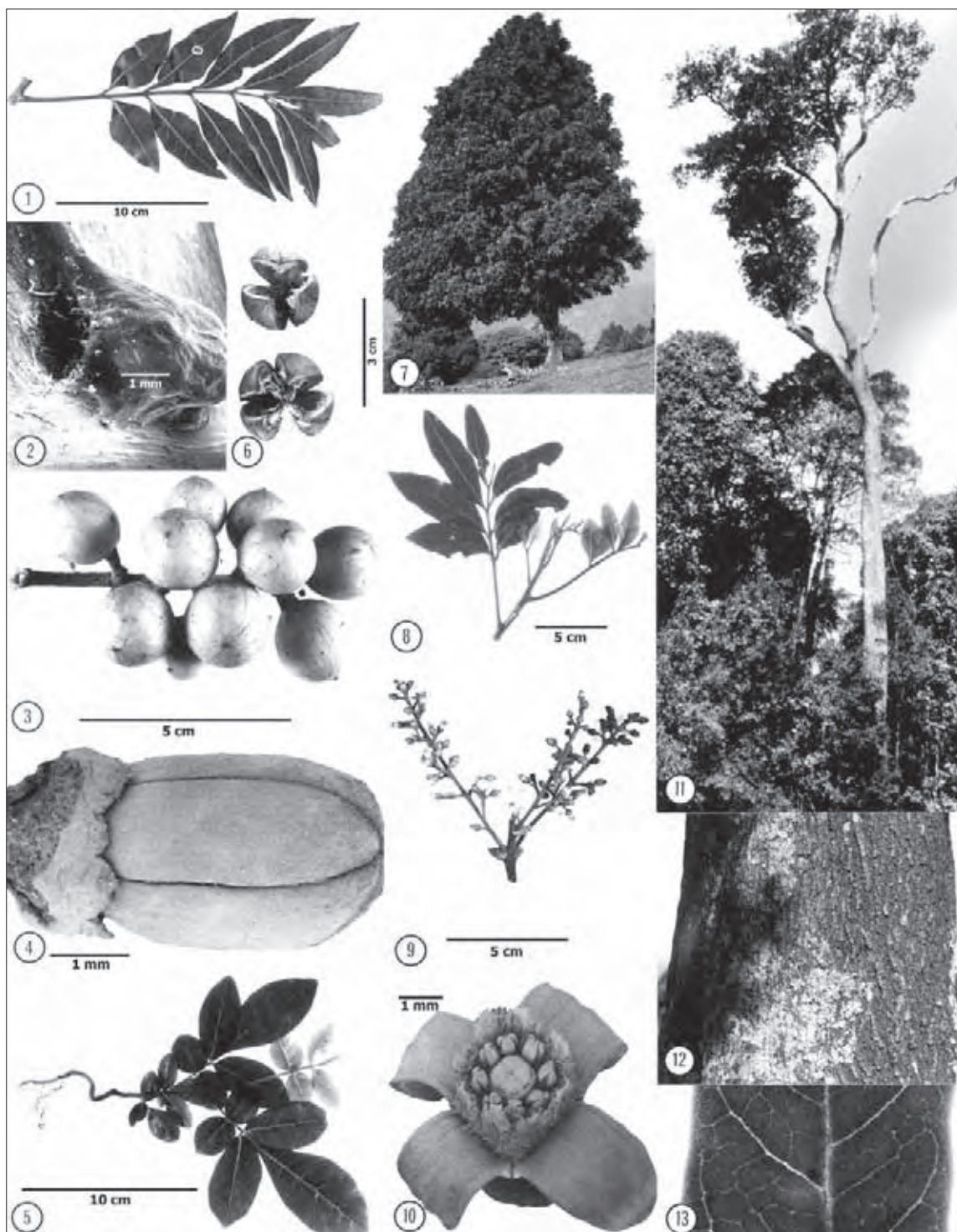
Inflorescences: Panicles in the upper axils, short, loose, divaricately branched, slightly pubescent. Flowers are fragrant. Calyx cupular, about 0.2–0.4 × 0.3–0.4 cm, very shortly and broadly 4–5 lobed. Petals 4–5, cream to light mauve, often recurved, about 0.2–0.3 × 0.4–0.6 cm, nearly glabrous, adhering to the staminal tube for about half their length. Staminal tube emergent, 8- to 10-toothed, about 0.3–0.4 × 0.2–0.4 cm, both sides sparsely covered by long white simple hairs. Anthers 8–10, sessile, about 0.1 cm long and alternate with the teeth. Disc tubular, glabrous, with an undulate rim. Ovary 3-locular with 2 ovules in each cell. Base of style and top of ovary covered in long, more or less erect hairs, stigma broad and conspicuous. Flowers mainly Apr.–June.

Fruits: Globular or somewhat pear-shaped, 1.5–4 cm diameter, containing 3–4 cells with each cell containing 1–2 large, lustrous, red seeds, 0.6 × 0.6 cm. When ripe each fruit is rosy red in colour and dehisces in 3–4 longitudinal slits from the top to near the base of the fruit. Mature Feb.–May or as late as Nov.

Wood: Sapwood much paler than heartwood and readily distinguishable, susceptible to *Lyctus* attack; heartwood light to dark reddish brown and durable, distinctive odour similar to that of a rose, fine uniform texture, interlocked grain but dresses easily, density 595–791 kg m⁻³. Some trees produce wood that contains an oil which tends to 'sweat' from the wood causing blotchy surfaces with finishes. The timber is similar to miva mahogany (*D. muelleri*) and was used for furniture, plywood, turnery, carving and joinery.

Climate: Altitudinal range: 30–900 m; Hottest/coldest months: 26–30°C/2–8°C; Frost incidence: moderate (upland sites receive occasional snowfalls in most years); Rainfall: 1000–1700 mm per year, summer max.

Distinctive features: Rose-like odour of the underbark and sapwood, scaly bark and leaflets equal-sided at the base. Large, raised glands on the underside of the leaflets, and rosy-red, globular-shaped fruits.



Dysoxylum fraserianum 1. Adult leaf with circle on leaflet marking position of domatia 2. Domatia with entrance (S.E.M.) 3. Fruits (closed) 4. Floral bud (S.E.M.) 5. Seedling 6. Fruits (opened) 7. Tree (open growing) on Dorriggo Mtn, near Dorriggo, N.S.W. 8. Pair of adult leaves 9. Inflorescence (buds) 10. Flower (S.E.M.) 11. Tree, Cangai State Forest, near Grafton, N.S.W. 12. Bark 13. Adult leaflet nervation

Red Cedar

Toona ciliata M. Roem

Red cedar is a tall deciduous tree usually up to 40 m in height and with stem diameters, above buttresses, of 3 m. The largest specimen in New South Wales is 54.5 m tall. The tree crown is very open with large spreading limbs displaying the light green foliage delicately and more or less horizontally. Tree boles are often irregular in cross-section and older trees are often buttressed at the base with buttresses extending well up the trunk. Trees are fully deciduous and the new spring foliage is bright red, becoming bronze-tipped and then green with increasing age.

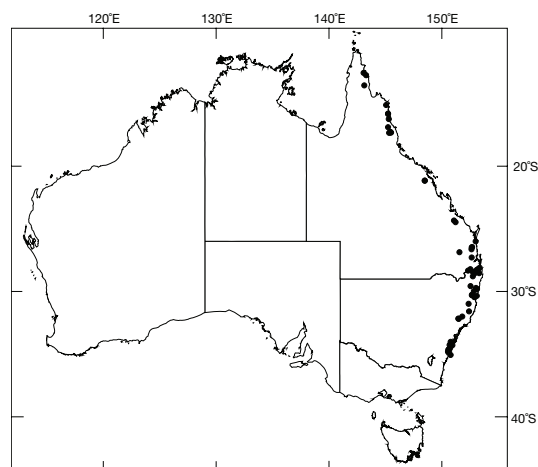
This species occurs along the eastern coast of Australia. The main distribution is between Ulladulla, New South Wales, and Gympie, Queensland. Farther north disjunct populations occur on the Eungella Range west of Mackay and around the Atherton area, near Coen, with the most northerly occurrence beside the Claudie River. Outside Australia the species extends to New Guinea. Because of extensive logging in the past, only remnant stands remain primarily in scattered remote localities in New South Wales and on the Eungella Range and Atherton Tableland in Queensland.

Red cedar prefers rich alluvial or volcanic soils for its best development and grows in moist gullies or along stream banks in wind-sheltered positions. Before European settlement the species was plentiful along the banks of most coastal rivers within its overall distribution. On the 'Big Scrub', Dorrigo and Levers Plateau, the Border Ranges and the McPherson Ranges it grows on ferrosols derived from basalt. It also persists in deep sheltered gorges in foothills of the tablelands.

The species occurs in a wide range of rainforest types from warm temperate (simple notophyll vine forests) to subtropical (complex notophyll vine forests) and tropical rainforests (mesophyll vine forests). Trees once occurred in small groves but more often these days remnant stands consist of only a few individual trees. Typical associates include white and black booyong (*Argyrodendron trifoliolatum* and *A. actinophyllum* at lower and higher altitudes respectively), red carabeen (*Geissois benthamiana*), sassafras (*Doryphora sassafras*), yellow carabeen (*Sloanea woollsii*) and occasionally hoop pine (*Araucaria cunninghamii*).

Typical specimens of red cedar can be observed on Cambewarra Mountain and on the coastal escarpment near Dorrigo, New South Wales. Attempts to raise plantations of red cedar have been thwarted by severe attack by the cedar tip moth (*Hypsipyla robusta*) on the flowers, fruits and growing tips.

Related species: The family Meliaceae includes other important tree species such as rosewood (*Dysoxylon fraserianum*). There are no other species of *Toona* in Australia. A form growing in the upper Clarence River area of New South Wales has a dense velvet-like covering of short hairs on the



undersides of adult leaves (A.G. Floyd, personal communication).

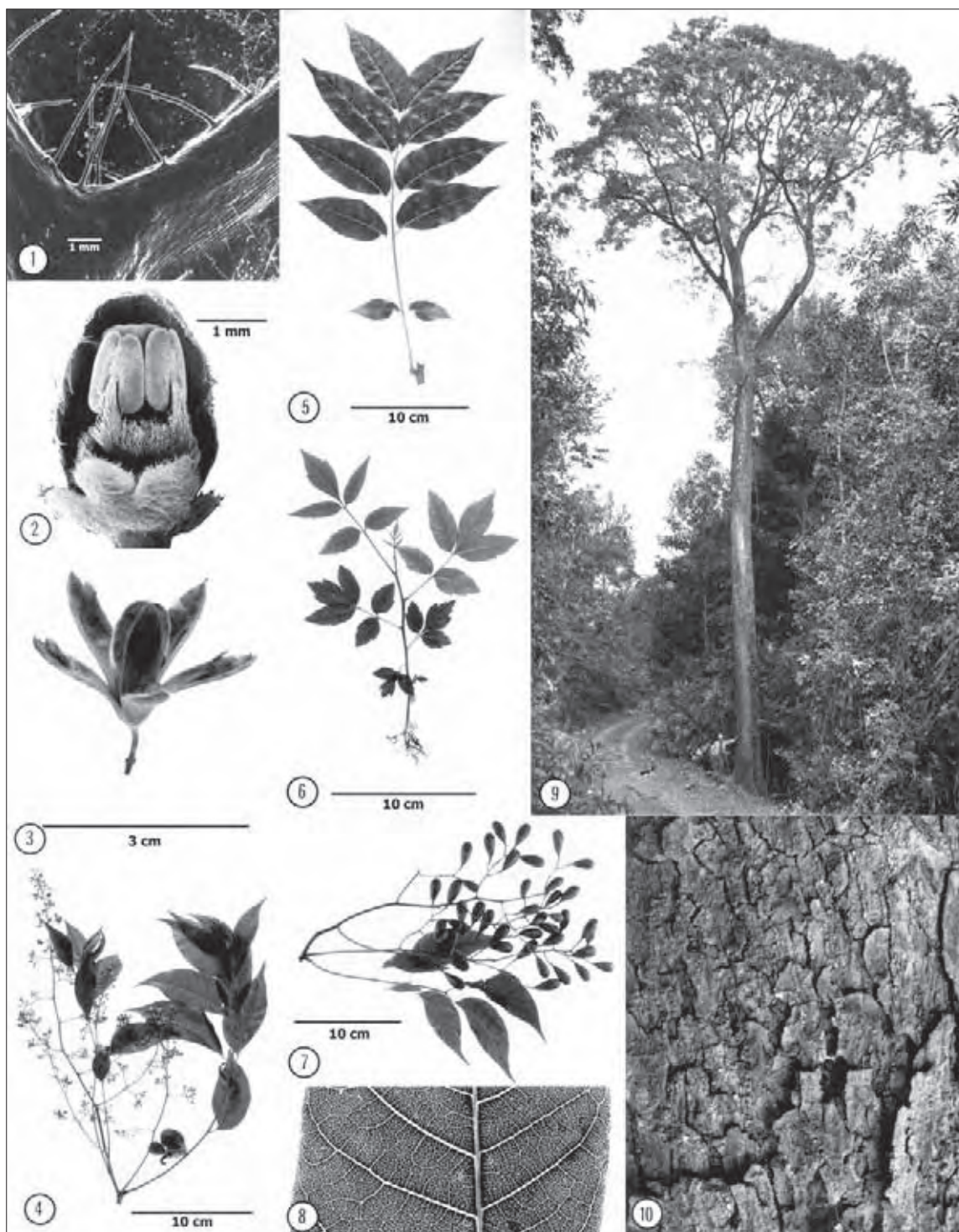
Publication: *Synops. Monogr.* 1, 139 (1846). Type: Madras, India.

Names: Botanical—*Toona*, from the Indian colloquial word 'Toon'; *ciliata* Latin (fringed with hairs) alluding to the leaf rachis and the newly emergent leaves which are noticeably hairy. Common—red because of the wood colour; cedar, presumably because of its scented timber: in this sense it resembles the scented timbers of cedars (*Cedrus* spp.) and the Spanish cedars (*Cedrela* spp.).

Bark: Grey to brown, very scaly and rough to the smaller limbs. Outer blaze pink to red, rather fibrous and with a fragrant odour.

Leaves: Cotyledons—petioles about 0.2 cm long, blades elliptical, about 1 × 0.5 cm; hypocotyl green with very short white hairs. Seedling—alternate, petiolate, first leaf pair trifoliate, middle lobe with 2–4 small teeth, two outer lobes lanceolate and nearly entire. Subsequent leaves imparipinnate, about 5–7 leaflets per compound leaf, leaflets opposite, lanceolate, about 3–5 × 2–3 cm, with irregularly toothed margins; leaf rachis noticeably hairy on the upper side as are also the newly emergent leaves. Adult—alternate, imparipinnate, petioles bulbous at base; leaflets dark green above, light green below; leaflets in 4–8 opposite to subopposite pairs, each leaflet resembles an ordinary leaf with petiolules 0.4–0.7 cm long, leaflet blades oblique at their bases by as much as 0.5 cm, ovate-lanceolate, acuminate, about 7–12 × 3–4 cm, leaf lamina often raised or depressed between main lateral veins giving the lamina a rippled surface; very small and indistinct hairy sunken pits in the forks between the main and lateral veins on the undersurface of the leaf.

Inflorescences: Large, terminal, occasionally axillary, pendulous panicles, up to 40 cm long, pyramidal and many-flowered. Rachis and young bracts sparsely covered with short white hairs. Flowers fragrant, calyx 5-lobed, each lobe about 0.1–0.2 cm long. Petals 5, white or pinkish, oval, 0.4–0.6 cm long, edges fringed with small hairs. Stamens 5, free, about 0.2 cm long, anthers dorsifixed and half as long as the stamens. Ovary and base of filaments covered in short hairs. Ovary 5-



Toona cilitata 1. Foveola on the underside of a mature leaf (S.E.M.) 2. Flower with half the petals removed (S.E.M.) 3. Fruit after dehiscence 4. Inflorescence with buds and flowers 5. Adult leaves 6. Seedling 7. Fruiting branch 8. Adult leaf nervation 9. Tree, near Atherton, Qld 10. Bark

celled, reddish, tapering into a style about 0.2 cm long topped by a broad, round, flat-topped stigma about 0.1–0.15 cm diameter. Flowers Oct.–Dec.

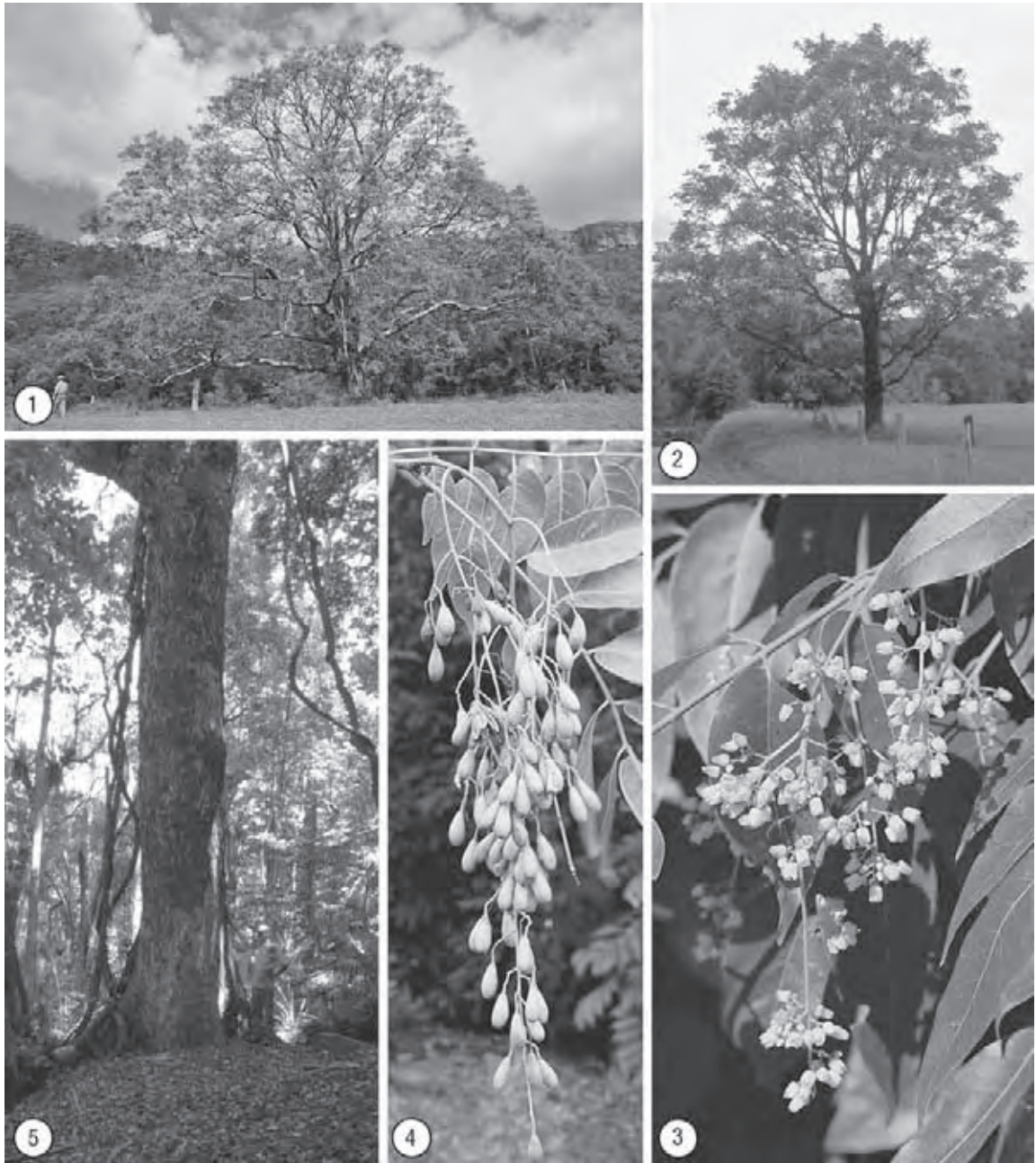
Fruits: Dry, thin-walled oblong capsules, $2-3 \times 0.8-1.2$ cm, 5-valved. Seeds $1-2 \times 0.3-0.5$ cm, about 5 per loculus, light brown and membranously winged at one or both ends. Fruit dehisces septifragally. Mature Jan.–Mar.

Wood: Sapwood yellowish white, susceptible to *Lyctus* attack; heartwood pink to rich red-brown and with a distinctive pleasant odour, growth rings distinct particularly on backcut boards, attractive figure often with beautiful fiddleback, durable, seasons quickly, soft, density $338-565 \text{ kg m}^{-3}$. Pores are visible to the naked eye and distinctly larger and more numerous in the early wood. The timber was a popular furniture wood in the past because it was easy to work and

took a good finish; it is often confused with true mahogany (*Swietenia*). Wood is used for boat building and turnery, but its rarity these days prohibits its use to any great extent. Some logs are brought into Australia from Papua New Guinea, and suren (*Toona sureni*) from South-East Asia has wood that has similar properties and is a close replacement.

Climate: Altitudinal range: near sea level to 1100 m; Hottest/coldest month: $26-31^\circ\text{C}/5-10^\circ\text{C}$; Frost incidence: mainly low but upland sites receive a few each year; Rainfall: 1200–3800 mm per year, summer max.

Distinctive features: A rough, scaly-barked, deciduous tree with alternate pinnate leaves, a pink to red fragrant blaze and 5-valved capsules, which dehisce septifragally. The new foliage in spring is bright red and very distinctive in the forest.



Specimens of red cedar (*Toona ciliata*) are still present in areas where once large commercial stands were harvested. 1, 2. Open-grown remnant trees on farmland near Wollongong, N.S.W. (1) and in the Bellinger Valley, N.S.W. (2) 3. Inflorescences 4. Fruits 5. Tall tree in rainforest on Mt Keira, near Wollongong, N.S.W.

Acacias

Acacias occur in all continents except Europe and Antarctica. They are particularly well developed in Australia, the New World and Africa. There are more than 1350 published species, of which over 950 occur in Australia. Australian species vary from prostrate shrubs about 0.5 m tall such as *A. depressa* and *A. pulviniformis*, to large forest trees attaining up to 35 m in height, e.g. *A. bakeri*, *A. celsa* and *A. melanoxylon*. The genus is particularly characteristic of the arid and semi-arid climatic regions and is common in much of the sub-humid region.

The genus was first described in 1754 by Philip Miller (1691–1771); the description being based on ‘the Egyptian thorn’ (*A. nilotica*). The generic name is derived from the Greek *akazo* (I sharpen), in allusion to the spiny stipules of many African and Asiatic species.

In Australia, acacias are commonly known as wattles. This name originates from early English where it denoted ‘interlaced rods and twigs as material of fences, walls and roofs (plastered with mud and clay)’; it was adopted by early Australian settlers because of the similarity of the twigs and branchlets of coastal species to those of plants used in England for ‘wattle’ construction. The name wattle is often incorporated in the common names of the species, e.g. black, green or silver wattle, while for many inland species euphonic Aboriginal names have been retained: brigalow, cooba, gidgee, mulga, myall and yarran.

Many *Acacia* species are among the most spectacular flowering plants of Australia. Individual flowering specimens are conspicuous in the landscape and are often covered in a mass of yellow blossom for several weeks. The flowers occur in heads 0.5–1 cm in diameter or in spikes up to 10 cm or more in length, with yellow colours predominating, although varying from

almost white to deep orange-yellow; one species, *A. purpureapetala*, has purple flowers; an individual plant of *A. leprosa* was discovered recently which has red flowers (marketed as ‘Scarlet Blaze’). One of the best-known species is Cootamundra wattle (*A. baileyana*), which is extensively planted as an ornamental. Among the many other colourful flowering species are *A. pycnantha*, *A. spectabilis* and *A. elata*. Golden wattle (*A. pycnantha*) was proclaimed as Australia’s official National Floral Emblem in 1988 and Wattle Day became an established springtime anniversary in many States. The wattle motif is prominent in the Australian coat of arms and in all levels of the honour award of Order of Australia, which was initiated in 1976.

The foliage of acacias is very distinctive. In the seedlings of most species the first few leaf pairs have pinnate or bipinnate leaves, e.g. *A. mearnsii*. In some species this leaf condition is maintained at subsequent leaf nodes, e.g. *A. baileyana*, while in others the foliage gradually assumes a phyllodinous condition, e.g. *A. melanoxylon*. The leaf blades become progressively reduced and the petioles become enlarged and flattened (usually in a vertical plane but a few species have horizontally flattened phyllodes, e.g. *A. binata*). Phyllodinous species dominate the Australian acacia flora and rarely occur outside Australia (this contrasts with the mostly bipinnate African and Asiatic species). A number of Australian acacias have very sharp, rigid phyllodes, e.g. *A. ulicifolia*, while some, e.g. *A. rubida*, have a distinctive gland (extra-floral nectary) on the upper edge of the phyllode. There are only a few Australian species with spines compared with African acacias, but two exceptions are *A. paradoxa*, with spines consisting of spinescent stipules, and *A. pulchella*, with spines consisting

of reduced branches (these occur at the node together with a pair of membranous stipules). In the late 1700s and even the very early 1800s many of the softer-leaved bipinnate and some phyllodinous species were referred to the genus *Mimosa* and only later transferred to *Acacia*.

Taxonomy

An early classification of the genus was made by C.L. Willdenow in 1806 who listed 102 species. George Bentham drew up a classification in 1842, which he amended in 1864 and 1875 (Table 2). His 1864 system has particular reference to Australia; here the genus was divided into six series with about 300 species being recognised. He placed emphasis on features of foliage, on whether or not the plants were armed or, if armed, upon whether or not the stipules were spinescent. Bentham was well aware of the deficiencies in his classification (he made limited use of the inflorescence and no use of legume characters) but many of his decisions were, of necessity, based on specimens which, by modern standards, would be considered inadequate. Bentham's classification, with comparatively minor amendments, is still used by present-day systematists and it appears most likely that many of his groupings will stand, despite the increasingly wide range of characters used as the basis for classification.

Vassal (1972) attempted to define precisely the subdivisions of the genus and to determine their degree of relationship. He took into consideration pollen characters, cytology and seed characters as well as the older criteria of inflorescence, pod and vegetative systems. The divisions established by Bentham in 1875 were re-evaluated and rearranged (Table 2). Following Vassal, Pedley (1978) also viewed *Acacia* as comprising three large subgenera, but later Pedley (1986) raised the subgenera to genus level as *Senegalia*, *Racosperma* and *Acacia* respectively. For various reasons, the recognition of subgenus *Phyllodineae* (the phyllodinous, mainly Australian species) as genus *Racosperma* has not been widely accepted (e.g. see Maslin 1989). Advances in the systematics of *Acacia sens. lat.* have been discussed by Maslin *et*

al. (2003) and nomenclatural issues regarding the name *Acacia* were presented by Orchard and Maslin (2003). As a result of this latter initiative it now appears that subgenus *Phyllodineae* will be formally recognised as genus *Acacia* based on a new type (*A. penninervis*).

Pedley (1978) has been the most widely used classification of subgenus *Phyllodineae* in Australia. Seven sections are recognised—*Alatae*, *Botrycephalae*, *Juliflorae*, *Lycopodiifoliae*, *Phyllodineae*, *Plurinerves* and *Pulchellae*—based broadly on Bentham (1875). With the exception of the *Alatae*, these groups were used and discussed at length by Maslin (2001a) who considered them a useful framework but noted that they do not clearly resolve all species.

The largest section is the *Phyllodineae* with over 400 species. This section is endemic to Australia and comprises mainly temperate species. Species are characterised by single-nerved phyllodes and globular flower heads, which may be either simple or occur in racemes. Some of the racemose species of this section are closely related section *Botrycephalae*. This section is endemic to eastern Australia and contains over 40 species. They have bipinnate adult leaves rather than phyllodes and racemose inflorescences with globular flower heads. The close relationship of the *Phyllodineae* and *Botrycephalae* is supported by a number of confirmed or suspected infrasectional hybrids (e.g. *A. dealbata* × *A. podalyriifolia*).

Sections *Juliflorae* and *Plurinerves* have over 235 and 210 species respectively with a handful of species represented outside Australia, e.g. *A. confusa* (Taiwan, Phillipines), *A. heterophylla* (Mascarene Islands), *A. koa* (Hawaiian Islands), *A. richii* (Fijian Islands) and *A. simplex* (Samoa, Tonga, Fiji, New Caledonia, New Hebrides). These two sections comprise the greatest number of arborescent species. Their phyllodes have numerous nerves, in contrast to the single-nerved phyllodes of sect. *Phyllodineae*. Phyllode nervation patterns range from a fine net-like reticulum to straight, non-reticulated longitudinal nerves. The two groups are distinguished based on flower head shape with the *Juliflorae* having cylindrical spikes and the *Plurinerves* globular

Table 2. Nomenclature used by Bentham (1875), Vassal (1972), Pedley (1978 & 1986) and Maslin *et al.* (2003) in their respective classifications of *Acacia* sens. lat. Higher taxonomic levels are in bold; Gen. = genus, Subgen. = subgenus, Sect. = section, Ser. = series, Subser. = subseries.

Bentham (1875)	Vassal (1972)	Pedley (1978)	Pedley (1986)	Maslin <i>et al.</i> (2003)*
Gen. <i>Acacia</i>	Gen. <i>Acacia</i>	Gen. <i>Acacia</i>		
Ser. <i>Gummiferae</i>	Subgen. <i>Acacia</i>	Subgen. <i>Acacia</i>	Gen. <i>Acacia</i>	Gen. <i>Vachhiella</i> (over 160 mainly New World, African & Asian spp.)
Ser. <i>Vulgares</i>	Subgen. <i>Aculeiferum</i>	Subgen. <i>Aculeiferum</i>	Gen. <i>Senegalia</i>	
Ser. <i>Filicinae</i>	Sect. <i>Filicinae</i>	Sect. <i>Monacantha</i>	Sect. <i>Senegalia</i>	Gen. <i>Senegalia</i> (over 200 mainly New World, African & Asian spp.)
		Sect. <i>Aculeiferum</i>	Sect. <i>Filicinae</i>	Gen. <i>Acaciella</i> (c. 15 New World spp.)
		Sect. <i>Filicinae</i>		Gen. '<i>Mariosousa</i>' (c. 13 New World spp.)
	Subgen. <i>Phyllodineae</i>	Subgen. <i>Phyllodineae</i>	Gen. <i>Racosperma</i>	Gen. <i>Acacia</i> (over 960 spp. mainly in Australia)
Ser. <i>Botrycephalae</i>		Sect. <i>Botrycephalae</i>		
Ser. <i>Phyllodineae</i>				
Subser. <i>Uninerves</i>	Sect. <i>Uninervea</i>	Sect. <i>Phyllodineae</i>	Sect. <i>Racosperma</i>	
Subser. <i>Alatae</i>		Sect. <i>Alatae</i>		
Subser. <i>Plurinerves</i>	Sect. <i>Heterophyllum</i>	Sect. <i>Plurinerves</i>	Sect. <i>Plurinervia</i>	
Subser. <i>Juliflorae</i>	Subsect. <i>Spiciferae</i>	Sect. <i>Juliflorae</i>		
Subser. <i>Brunioideae</i>		Sect. <i>Lycopodiifoliae</i>	Sect. <i>Lycopodiifoliae</i>	
Ser. <i>Pulchellae</i>	Sect. <i>Pulchelloidea</i>	Sect. <i>Pulchellae</i>	Sect. <i>Pulchellae</i>	

*Nomenclature likely to be adopted following the success of the proposal by Orchard and Maslin (2003).

flower heads. In some species, however, the distinction between the two states is blurred, i.e. some species have obloid heads and both head shapes may be represented in otherwise allied taxa. Simple and racemose inflorescences are represented in both groups and, as with the *Phyllodineae* and *Botrycephalae*, intersectional hybrids between the two groups are known. As noted by Maslin *et al.* (2003), further study of these large sections is required before a more meaningful infrageneric classification can be elucidated.

Species from the endemic sections *Alatae* (c. 20 spp. from south-western Western Australia), *Lycopodiifoliae* (c. 17 mainly tropical spp.) and *Pulchellae* (c. 27 spp. from south-western Western Australia) comprise mainly low shrubs. Subgenus *Acacia*/gen. *Vachhiella* has over 150 species represented in the New World, Africa and Asia with about seven species endemic to tropical Australia. There are two species (one endemic) from subgen. *Aculeiferum*/gen. *Senegalia* in Australia, both

occurring as woody vines in the rainforests of far north-eastern Queensland. None of these latter groups are represented by species treatments presented here; for more information the reader is referred to Maslin (2001a) and Maslin *et al.* (2003).

Identification

A principal character used in most keys for the identification of species is the foliage. The nervation of the phyllodes is of considerable importance, i.e. one-nerved versus numerous nerves while both in the phyllodinous and bipinnate species glands (extra-floral nectaries) are useful but indumentum less so. Stipules are useful but they may be minute or early deciduous. The type of inflorescence, i.e. simple versus racemose, is of major importance, while the approximate number of flowers in a head can be of value in identification. When available the pods are helpful in separating species—whether pods are straight, twisted or coiled; whether parallel-sided

or moniliform and whether the seed is aligned transversely or longitudinally in the legume. The seeds and their appendages are sometimes of great value in separating two species, which may have a superficial resemblance in the field, e.g. a difference in arils will readily separate *A. implexa* from *A. melanoxylon* (the aril completely surrounds the seed in *A. melanoxylon*). Accurate identification of wattles has recently been greatly facilitated with the advent of electronic interactive identification. Maslin (2001) is a LUCID-based electronic key that enables the user to readily identify 1165 wattles from throughout Australia.

Biology

There is a marked difference in the longevity of species and, while detailed records are not available, certain generalisations are possible. *Acacia baileyana*, a shrub of the sub-humid area, when planted on dry and otherwise unfavourable sites may commence to deteriorate at 10–12 years. Many of the large shrub/small tree bipinnate species of the coastal area may grow very fast in early life, e.g. average 2 m a year for 5 years, and have a life span of 25–50 years. Medium to large shrubs of the dry country, however, appear to have longer lives and in the case of *A. catenulata* one small tree has been recorded as over 50 years of age and still vigorous. Of undoubted longevity is *A. melanoxylon*, which probably exceeds 100 years, and waddy (*A. peuce*), dated at 500 years old.

The seed of most acacias has an almost impervious testa and may remain viable up to at least 20 years. Pretreatment before sowing is necessary to break the dormancy; the simplest way for many species is to place the seed in water which has just boiled and allow it to cool. One striking exception is the seed of *A. harpophylla* which, if not stored at freezing or subfreezing temperatures, may only remain viable for 0.5–2 years. The average number of seeds per kilogram for most acacia species is in the range 40 000–60 000.

Overseas experience, especially in areas of moderate rainfall—say 750–1250 mm—is that acacias introduced from Australia may become a

weed and displace native vegetation. Two possible explanations are that fire may destroy native fire-sensitive shrubs while inducing germination of acacia seed, or that the introduced acacias are less critical in their nutrient requirements. In addition, the introduced species often have a faster early growth rate and are free from natural pests and predators in their new environment.

Uses

Associated with their widespread natural occurrence, acacias also play an important role in soil conservation, as a source of nitrogen in forest ecosystems and as fodder plants. Not only are they of use as drought fodder but in the drier parts of the continent they have an important role as browse plants. Some authorities consider that *A. aneura* is the most important fodder tree in Australia because it is widespread, abundant and usually palatable although not notably nutritious. It is mainly a fodder for sheep. With this, as with some other species, there is considerable geographic variability in palatability and local observations are needed before lopping is done in time of drought. Most acacias cause impaction in stock if eaten as the sole diet and are better when taken as a supplement to other food. Among other phyllodinous species eaten are *A. coriacea*, *A. excelsa* and *A. pendula*, while less favoured are *A. brachystachya*, *A. cana* and *A. georginae*. Only a few bipinnate species are eaten by stock, such as *A. deanei* and *A. farnesiana*, with the latter having its main natural occurrence overseas. In Europe some species are grown for the flowers and sold under the name of ‘mimosa’. The flowers, however, while producing a moderate amount of pollen are generally of limited value as a source of nectar for honey production. Acacias are useful for shade, shelter and ornamental planting, though care has to be taken in the selection of species and their probable longevity.

Wattleseed as a source of human food has been a subject of increasing interest and research in recent years. Much of this work is based on an understanding of traditional Aboriginal use. Harwood (1994) documented species such as *A. elachantha* (kalkardi), *A. thomsonii*

(Thomson's wattle), *A. tumida* (Pindan wattle) and particularly *A. colei* (Cole's wattle), as showing promise as a new source of human food in semi-arid regions of the Sahel, West Africa. The seeds are readily processed using local technology and the ground flour has been incorporated into local recipes. These species were originally introduced into Africa for fuelwood and windbreaks and they are still used in these roles. In Australia, wattleseed is used in the bushfood industry and ground roasted seeds are mainly used for flavouring sauces and ice cream, and in breads, pasta and biscuits. Most of this seed is currently collected from natural populations of gundabluey (*A. victoriae*) but other species, including *A. colei* are also important. Maslin *et al.* (1998) identified 47 species as having potential for edible seed production in southern Australia.

The bark of most acacias has significant tannin content which, in some species, may be as high as 45 per cent. One of the most notable in this respect is *A. mearnsii*, which is cultivated extensively in South Africa, and *A. pycnantha*

from which bark was formerly collected in southern Australia. The sapwood of most species is very narrow—usually less than 2 cm—while the heartwood is typically dark in colour (dark brown to almost black, dark golden brown or yellow, sometimes streaked with dark yellow or red), heavy, hard, sometimes finely figured, strong, tough and usually durable in the ground. It can be worked to a fine finish and takes a high polish. Several species were highly favoured by Aboriginal people for weapons, including spears and clubs, and for making boomerangs. In the earlier days of European settlement the wood was highly favoured for cabinet making and furniture, but because of its heaviness, is now less favoured than formerly. A modern use of *A. melanoxylon* is in sliced veneer on a lightweight base such as particleboard. Some woods have a distinctive scent, e.g. jam (*A. acuminata*), which has the fragrance of raspberry jam and myall (*A. pendula*), which has a violet-like fragrance. Further information on the uses of wattles is given in Doran and Turnbull (1997), McDonald *et al.* (2001) and Maslin and McDonald (2004).



Acacias are represented in most parts of Australia, ranging from tall forest trees to low sprawling shrubs. Some are cultivated overseas for their hardiness and rapid growth. 1. Gidgee (*Acacia cambagei*), Oodnadatta Track, S.A. 2. Granite wattle (*A. quadrimarginea*), near Laverton, W.A. 3. Cole's wattle (*A. colei*) cultivated in Maradi, Niger, for shade, firewood and human food. 4. Brigalow (*A. harpophylla*), near Adavale, Qld. 5. An exceptionally large ear-pod wattle (*A. auriculiformis*), Tiwi Islands, N.T.

Jam Raspberry Jam

Acacia acuminata Benth.

Jam commonly grows as a large, bushy shrub 3–5 m tall with a short main stem, which divides about 1 m from the ground into numerous fine spreading–erect branches. On very favourable sites in the western part of its occurrence it may be a small tree 10 m tall, with trunks 2–2.5 m in length. There are two subspecies, the typical and subsp. *burkittii*.

Subsp. *acuminata* occurs in south-western Western Australia where it is still common throughout the wheat belt, especially in an area 50–300 km inland from Perth and roughly parallel to the coast. It extends south from the Murchison River area to Borden and Ravensthorpe and east to Yalgoo, Kalgoorlie and Balladonia. Subsp. *burkittii* extends west from subsp. *acuminata*, through inland South Australia to the western plains of New South Wales.

Subsp. *acuminata* occurs mainly on gently undulating topography of the Yilgarn Plateau. The soils are often lateritic gravels, but range from pale brown clays and darker clays on flats to red sand and granitic gravels. Subsp. *burkittii* grows in low open woodlands and shrublands on plains or on dunes. Soils are often calcareous red or brown sandy loams or sands.

Jam attains its best development in woodlands where the main associated tree eucalypts are York gum (*E. loxophleba*) and salmon gum (*E. salmonophloia*). Associated shrubs include a wide range of acacias, especially *A. microbotrya*. Subsp. *burkittii* occurs in open shrublands often in dense pure stands or associated with numerous other acacias including mulga (*A. aneura*) communities and in the east poplar box (*E. populnea*), cypress pine (*Callitris glaucophylla*) and mallee eucalypt communities.

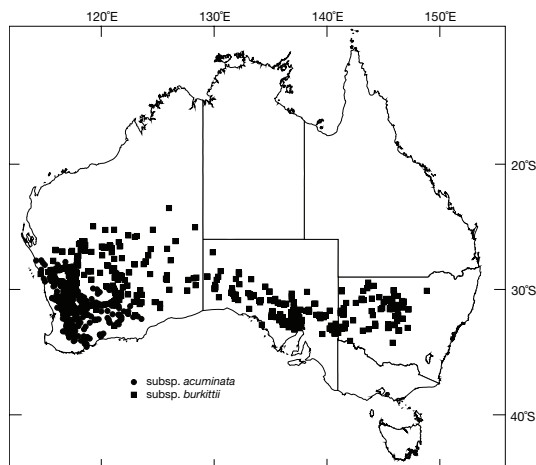
Related species: Jam (sect. *Juliflorae*) comprises a number of variants, documented by Maslin and McDonald (2004) and is allied to Oldfield's wattle (*A. oldfieldii*). This species mainly differs in having adult phyllodes with glabrous margins, longer peduncles and spikes that are less densely flowered.

Publication: Subsp. *acuminata*: Hooker's *London J. Bot.* 1, 373 (1842). Type: includes collections by J. Drummond, Swan River, and W. Baxter, King Georges Sound, Western Australia. Subsp. *burkittii* Kodala & Tindale: *Telopea* 7, 415 (1998). Type: Lake Gilles in the interior, South Australia, W.C. Burkitt.

Names: Botanical—Latin *acuminatus* (pointed, elongated, or tapering), in allusion to the drawn-out tips of the phyllodes; *burkittii* honours W.C. Burkitt (1839–1908), a sheep farmer who collected the type. Common—an allusion to the odour of freshly cut timber.

Bark: On the lower half of the trunk of trees 0.3 m diameter it is up to 2 cm thick, hard, deeply furrowed longitudinally, grey to dark greyish. On smaller stems it may be lighter in colour, grading to a smooth thin greenish grey bark above.

Foliage: Cotyledons—sessile, elliptical up to 0.4 × 0.2 cm. Juvenile—alternate, first leaf pinnate (3–5 pairs of leaflets) with two narrow acuminate stipules at the base of the compound leaf, becoming bipinnate (4–5 pairs of pinnae)



early and then phyllodinous at about node 2 or 3; phyllodes long, narrow, falcate with fine longitudinal nerves, up to 15 × 0.8 cm. Adult—phyllodinous, alternate, linear and sometimes falcate, slightly coriaceous, 7.5–25 × 0.1–0.9 cm (*acuminata*), or linear-filiform, upright, terete to subterete and only 0.05–0.2 cm wide and apex delicately curved (*burkittii*), nerves numerous, fine and parallel to the midrib, with 1–3 veins more prominent than the others, (*acuminata*) or the central nerve often more prominent (*burkittii*); ciliate particularly towards apices.

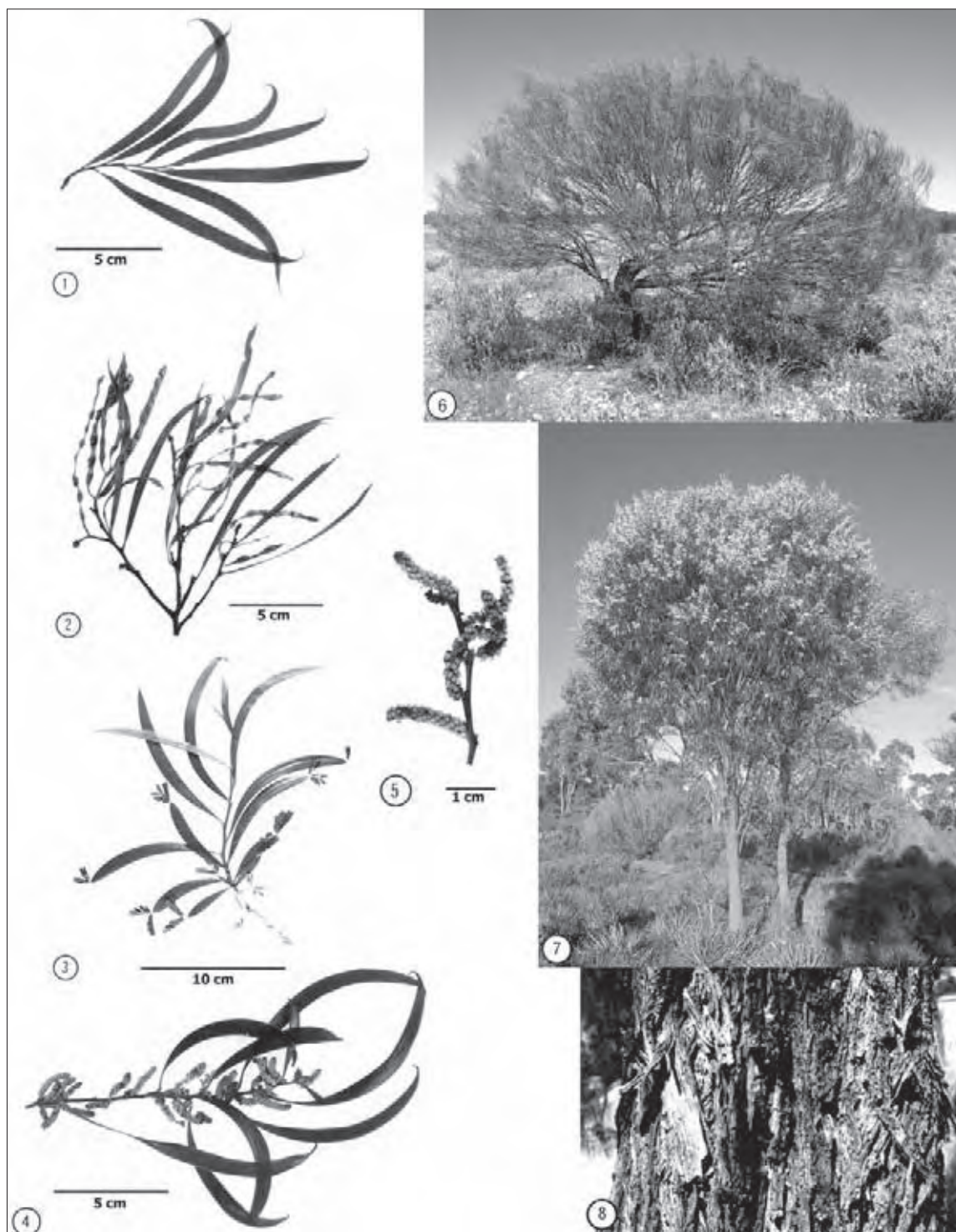
Inflorescences: Simple, axillary spikes, 1–2(–3) per axil, spikes 1–3.5 cm long (*acuminata*), or 0.5–1.5 cm long (*burkittii*), sessile or almost sessile, flowers densely arranged along rachis, bright yellow to golden; flowers mostly 4-merous, sepals partially fused. Flowers Jul.–Sept. (Oct.).

Fruits: Pods, linear, strongly raised over seeds, straight or slightly curved, (*acuminata*) or moniliform (*burkittii*), 5–15 × 0.3–0.7 cm, chartaceous, medium to dark brown. Seeds longitudinally aligned in pod, obloid to broadly ellipsoid or globoid, dark brown to brownish black, aril/funicular cream. Mature Nov.–Jan.

Wood: Heartwood dark reddish brown, with distinctive odour when freshly cut reminiscent of raspberry jam, very hard, very durable in the ground, very dense, density about 1040 kg m⁻³; grain close and fine-textured, attractive appearance often with fiddleback; boles favoured for round fencing material; wood is also used for ornamental articles, machine bearings and sheave blocks.

Climate: Altitudinal range: near sea level to 400 (*acuminata*), 110–520 m (*burkittii*); Hottest/coldest months 32–34°C/4–7°C (*acuminata*), 33–38°C/3–7°C (*burkittii*); Frost incidence: low to moderate; Rainfall: 225–500 mm per year, winter (*acuminata*), 130–440 mm per year, uniform (*burkittii*).

Distinctive features: Phyllodes acuminate, with numerous fine longitudinal veins, finely ciliate, particularly towards apices; spikes sessile or almost sessile; flowers mostly 4-merous; freshly cut wood is fragrant and reminiscent of raspberry jam.



Acacia acuminata: subsp. *acuminata* (a), subsp. *burkittii* (b) 1. Adult phyllodes (a) 2. Fruiting twig (a) 3. Seedling (a) 4. Flowering twig (a) 5. Flower buds 6. Shrub, near Wiluna, W.A. (b) 7. Tree, near Katanning, W.A. (a) 8. Bark

Mulga

Acacia aneura F. Muell. ex Benth.

Mulga varies from a shrub 2–5 m tall, with markedly ascending branches, to a small tree up to 9 m, with a well-defined main stem but less oblique branches, or it is sometimes a taller tree with lateral branching with a conifer-like habit. While the silvery-grey foliage is often distinctive, throughout its range there is marked variation in phyllode shape and width and hence crown appearance. To accommodate the variation evident in mulga, ten varieties have recently been recognised.

Mulga communities are widespread and occupy a significant proportion of the continent. They occur in all mainland States except Victoria, mainly south of latitude 20°S and west from near Shark Bay in Western Australia, east to the western plains of New South Wales and the Great Dividing Range in Queensland; it is sparsely represented in the Simpson Desert and the channel country of south-western Queensland.

Mulga grows most plentifully on flood and erosional plains and in broad valley heads, but occurrences also include hill slopes and ridges. In sand ridge deserts it may occur in the dune swales. Soil types vary but the denser stands are usually found on calcareous red loams and sands or red clayey sands and, sometimes, on sandy gravels. It is less common on lateritic and calcareous crusts or those of a markedly skeletal nature.

Most stands are in low open woodlands or, to some extent, tall open shrublands. It is also found in grassy open scrub or open shrubland where mallee eucalypts may be the dominant vegetation. While it often occurs in large, almost pure stands, it may also be found in close association with numerous other arid zone acacias and species from many genera with include *Eremophlia*, *Senna*, *Atriplex*, *Maireana*, *Triodia*, *Aristida*, *Halosarcia* and *Eragrostis*.

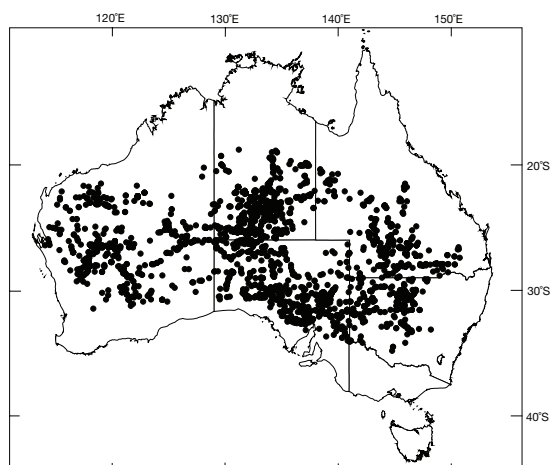
Related species: Mulga (sect. *Juliflorae*) represents a wide-ranging, polymorphic species complex. Pedley (2001) documented the 'mulga group' as four core species—*A. aneura* (with 10 varieties), *A. ayersiana*, *A. minyura* and *A. paraneura*—with six closely related species—*A. atopa*, *A. brachystachya*, *A. clelandii*, *A. craspedocarpa*, *A. ramulosa* and *A. subtessaragona*. Pods are usually required for the accurate identification of taxa, and intergrade stands are common.

Publication: *Linnaea* 26, 627 (1855). Type: Cudnaka, probably near Lake Torrens, South Australia, Oct. 1851, F. von Mueller.

Names: Botanical—Greek *a* (not), *neuron* (nerve), in allusion to the absence of conspicuous veins in the phyllodes. Common—mulga is the Aboriginal name.

Bark: At base of trunk compact, hard, somewhat shallowly corrugated longitudinally, thickness usually less than 1 cm, greyish. Upper parts thinner, smoother and often pale grey.

Foliage: Cotyledons—sessile, broadly oblong, about 0.6 × 0.3 cm. Seedling—first pair, alternate, paripinnate, approximately 2 pairs of leaflets, second pair bipinnate with leaflets opposite, obovate and oblique, about 0.7 × 0.3 cm



rapidly becoming phyllodinous at subsequent leaf nodes; the phyllodes are lanceolate, about 4 × 1.5 cm with 12–15 longitudinal veins, dark green, and coriaceous. Adult—phyllodes extremely variable in shape and size, straight or curved, terete to flat, 2.5–12.5 × 0.08–0.9 cm, with numerous, non-anastomosing longitudinal nerves (often barely visible with a ×10 magnifying lens), that have minute appressed hairs between them, often glabrescent, occasionally resinous.

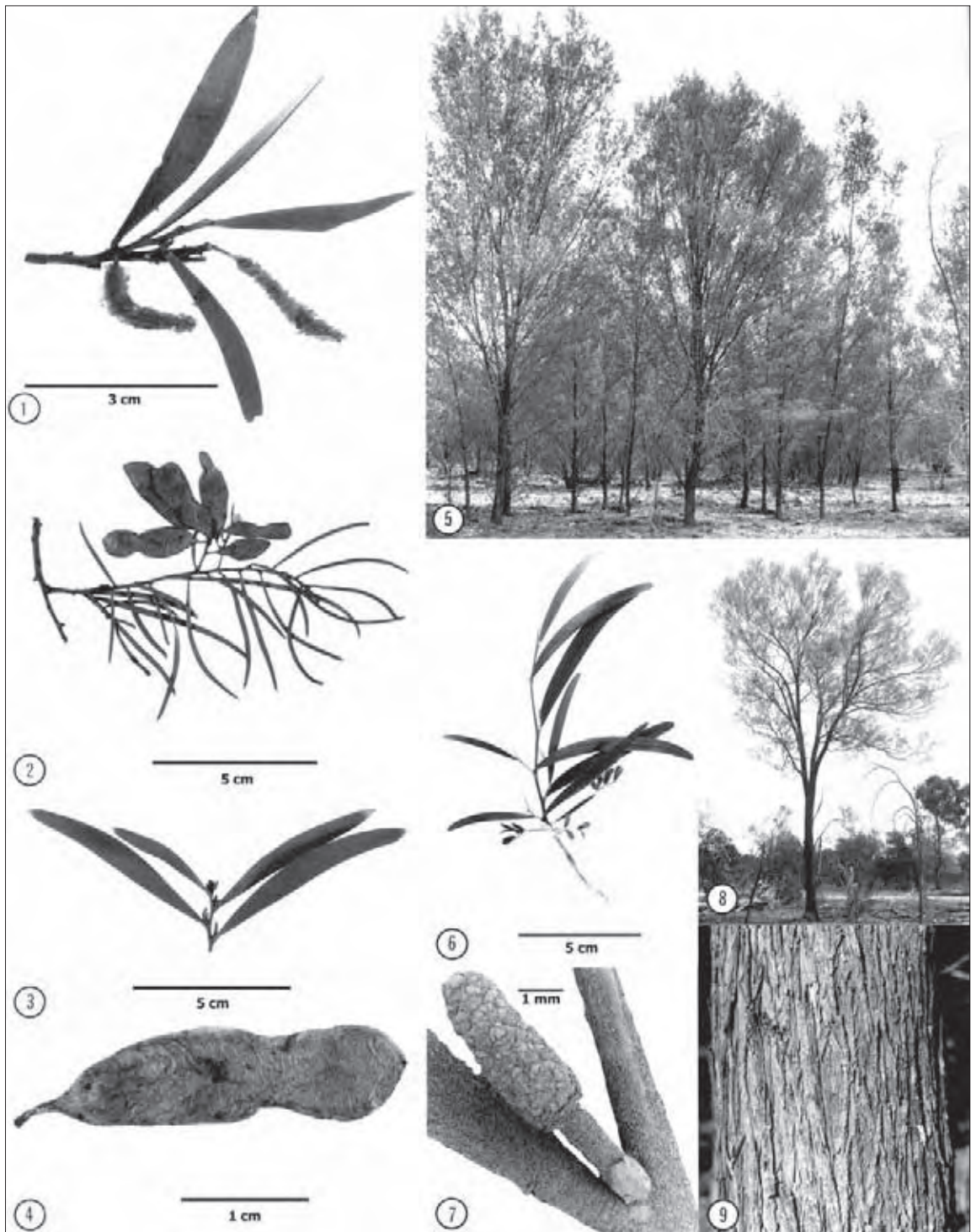
Inflorescences: Simple, axillary spikes, 1 per axil, spikes 0.7–3 cm long, peduncles 0.3–1 cm long, flowers densely arranged along the rachis; flowers 5-merous, sepals free or fused. Flowers irregularly, usually after good rains.

Fruits: Pods, oblong, straight, 2–10 × 0.7–1.7 cm, chartaceous or crustaceous, often brown and resinous when mature, reticulately nerved, with resinous marginal nerves or a wing to 0.2 cm wide. Seeds oblique to transversely aligned, oblong or oval, aril obliquely terminal, pileate, creamy white. Mature irregularly, usually after good rains.

Wood: Sapwood narrow, white; heartwood dark brown, with contrasting markings of golden yellow, very hard, fine-textured, very dense, density 1090 kg m⁻³. The wood turns well and takes a high polish. Aboriginal people used the wood for weapons such as spears, clubs and boomerangs, and it is still sometimes used for fencing. Present day use is mainly for small ornamental articles, especially those for tourists, and locally for fuel.

Climate: Altitudinal range: mainly 100–750 m; Hottest/coldest months: 36–40°C/5–8°C; Frost incidence: low to moderate (mean of 1–12 heavy frosts per year); Rainfall: 100–500 mm per year, summer max. or uniform.

Distinctive features: A common arid zone tree or shrub with phyllodes extremely variable in shape and size throughout its range; they may be straight or curved, terete to flat but notable in having numerous, non-anastomosing longitudinal nerves often barely visible with a ×10 magnifying lens; flower spikes single in axils; pods, flat, usually chartaceous, with resinous marginal nerves or a wing to 0.2 cm wide. Considered the most important fodder tree in Australia (Everist 1969).



Acacia aneura 1. Adult phyllodes and floral spikes 2. Adult phyllodes and pods 3. Adult phyllodes 4. Legume 5. Stand, 16 km west Morven, Qld 6. Seedling 7. Inflorescence spike at bud stage (S.E.M.) 8. Adult tree, between Bollon and Cunnamulla, Qld 9. Bark

Ear-pod Wattle Northern Black Wattle

Acacia auriculiformis A. Cunn. ex Benth.

Ear-pod wattle may be a tall tree up to 30 m tall on favourable sites with a moderately straight bole dominant for most of the tree height. More commonly it is a medium-sized tree 8–20 m tall heavily branched from a low height. The bole sometimes exceeds 1 m dbh. On exposed coastal sites it is a large shrub only 2–5 m tall. Open-growing specimens carry a moderately dense crown, which may be much wider than the plant is high.

Ear-pod wattle has a disjunct distribution in coastal and subcoastal Northern Territory from the Port Keats region west to Groote Eylandt and in north Queensland from Cape York south to Mount Molloy. It also occurs in the southern lowlands of New Guinea.

Most occurrences are on lowland sites along rivers, but it also occurs on the edges of sand dunes, behind mangrove swamps and along river levees and floodplains. Many sites are waterlogged during the wet season. In Queensland it extends from lowland sites to altitudes up to 400 m (e.g. Rifle Creek near Mount Molloy). Soils vary from sandy loams, clayey alluvials to black cracking clays. While usually derived from a wide range of basic depositional material, they also include calcareous coastal dune deposits (e.g. Cobourg Peninsula, Northern Territory).

Ear-pod wattle forms open woodlands, open forests or sometimes occurs in or near closed monsoon vine forests. Riparian occurrences are in narrow belts, where it may be the dominant species. It is mainly found in association with other riparian species, which include melaleucas (*M. argentea*, *M. leucodendra*, *M. cajuputi*, *M. dealbata*) and numerous monsoon vine forest species. Coastal associates include beach sheoak (*Casuarina equisetifolia*).

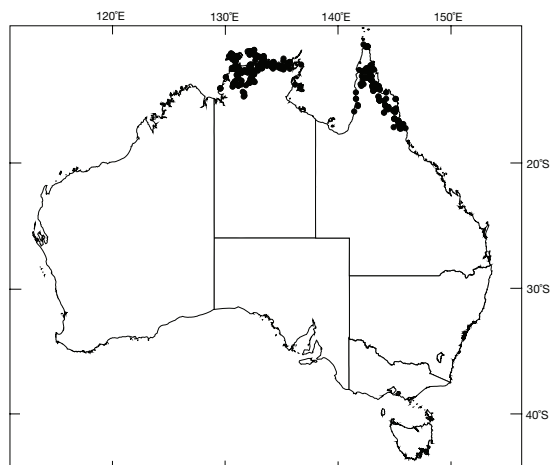
Related species: Ear-pod wattle (sect. *Juliflorae*) has some affinities with *A. mangium*, *A. cincinnata*, *A. spirorbis*, *A. leptocarpa* and *A. polystachya*. Natural hybrids involving ear-pod wattle and *A. mangium* are not uncommon where the two come into contact. *Mangium* is readily distinguished by its broader, obliquely elliptic to dimidiate phyllodes and by its narrower (3–5.5 mm wide) linear pods, which are coiled, twisted or spirally coiled. Natural hybrids with *A. leptocarpa* are also known.

Publication: *Hooker's London J. Bot.* 1, 377 (1842) as *A. auriculiformis*. Type: South Goulburn Island, off the coast of Northern Territory, collected during the voyage of the *Bathurst* in the period 1819–21, A. Cunningham.

Names: Botanical—Latin *auricula* (external ear of animals), *forma* (form, figure, or shape), in allusion to the shape of the pod. Common—alludes to the pod shape.

Bark: Lower part of trunk tends to be fluted; bark moderately thick, rough, longitudinally corrugated, dark to brownish grey.

Foliage: Cotyledons—elliptical at least 0.5×0.4 cm; hypocotyl green and slightly 4-sided and winged, glabrous. Seedling—first pair bipinnate (5–6 pairs of leaflets) then second pair becoming phyllodinous and following pair



completely phyllodinous. Adult—phyllodes dimidiate or falcate, acute or subacute, $10\text{--}16 \times 1.5\text{--}2.5$ (3) cm, glabrous: 3 prominent longitudinal veins running together towards lower margin or in middle near base; many fine crowded, somewhat anastomosing secondary veins.

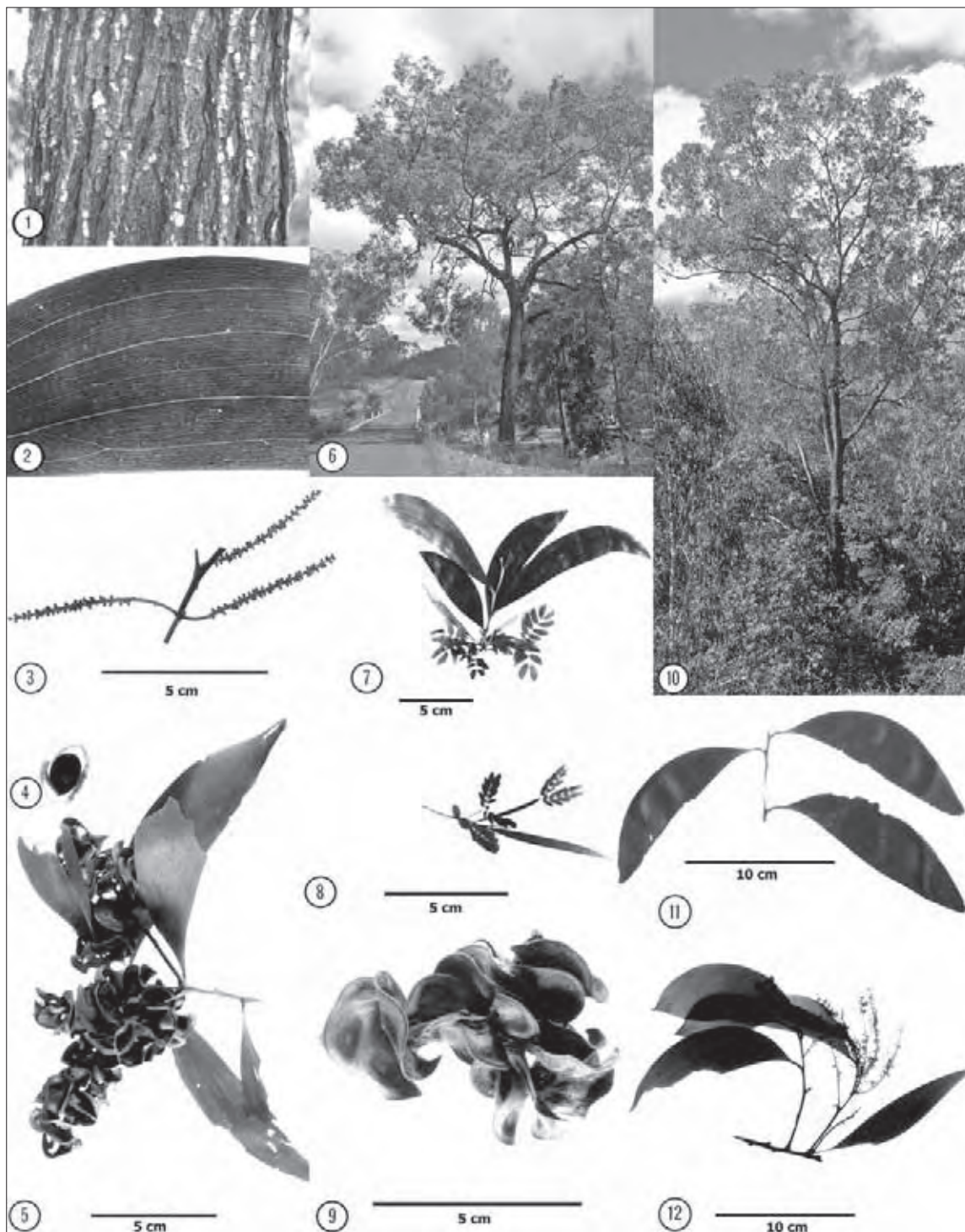
Inflorescences: Simple, axillary spikes, 2 per axil, spikes 5–8.5 cm long, flowers subdensely arranged along rachis, golden; flowers 5–merous, sepals partially fused. Flowers Mar.–Jul.

Fruits: Pods, curved to form an open coil, dorsal margin undulate, c. 6.5×1.8 cm, dehiscing along dorsal suture, rather woody, with prominent reticulate nervation, pruinose (mauve when fresh). Seeds transversely aligned, flattened, glossy, black; aril orange-red or yellow encircling the seed. At maturity seeds dehisce dorsally and dangle from the pod by the aril while still on the tree. Mature Sept.–Oct.

Wood: Sapwood yellow, up to 5 cm wide, susceptible to *Lyctus* attack; heartwood pale brown to reddish, moderately hard, fine-grained, often attractively figured and takes a satisfactory finish, susceptible to termite attack, density $575\text{--}640 \text{ kg m}^{-3}$; wood properties are favourable for furniture and paper pulp production, charcoal as well as firewood. Widely planted in Asia, Africa, South America for fuelwood, erosion control and as an amenity plant.

Climate: Altitudinal range: sea level to 400 m; Hottest/coldest months: $32\text{--}34^\circ\text{C}/17\text{--}22^\circ\text{C}$; Frost incidence: low; Rainfall: 1000–1500 mm per year, summer max.

Distinctive features: A riparian tree with relatively large slightly glossy, dimidiate or falcate phyllodes that have 3 prominent longitudinal veins; flower spikes in pairs, golden, flowers scattered along the rachis; pods flat, up to 1.8 cm wide, curved to form an open coil, dorsal margin strongly undulate; seeds flattened with an orange-red or yellow aril which encircles the seed.



Acacia auriculiformis 1. Bark 2. Adult phyllode nervation 3. Flower buds 4. Seed 5. Fruiting twig 6. Tree, Lankelly Creek, Qld 7. Seedling 8. Seedling with cotyledons 9. Pods 10. Tree, Stewart River, Qld 11. Adult phyllodes 12. Inflorescence and phyllodes

Marblewood White Wattle, Baker's Wattle, Scrub Wattle

Acacia bakeri Maiden

Marblewood is a tall tree, up to 45 m in height and with a dbh up to 90 cm. Larger trees may be moderately flanged at the bole. The crown may be somewhat pendulous and is spreading with dark green foliage. This species is considered to be one of the tallest wattle species in Australia, but since European settlement its occurrence has become localised and large specimens are rare.

The distribution of marblewood is restricted, extending from the Brunswick River in New South Wales, north to near the Burrum River in the Maryborough district of south-eastern Queensland.

Marblewood grows on subcoastal lowlands and subcoastal ranges. Soils are relatively fertile loams or sandy loams of volcanic or alluvial origin.

This species grows in or in close proximity to closed subtropical rainforests and in open forests fringing rainforests. It is associated with a wide range of species including brush box (*Lophostemon confertus*), white booyong (*Argyrodendron trifoliolatum*), yellow hollywood (*Premna lignum-vitae*), hoop pine (*Araucaria cunninghamii*) and numerous other rainforest tree species.

Related species: The affinities of marblewood (sect. *Plurinerves*) are uncertain. It has similarities with two-veined hickory (*A. binervata*), a coastal species from New South Wales and south-eastern Queensland which differs in being a smaller tree, having phyllodes with two prominent main nerves and 5-merous, glabrous flowers.

Publication: *Proc. Linn. Soc. New South Wales* ser. 2, 10, 337; t. 21 (1895). Type: Mullumbimby, Oct. 1894, R.T. Baker 1258.

Names: Botanical—after Richard Thomas Baker (1854–1941) a wood technologist and botanist with the Sydney Technological Museum in New South Wales. Common—refers to the hardness and colour of the wood.

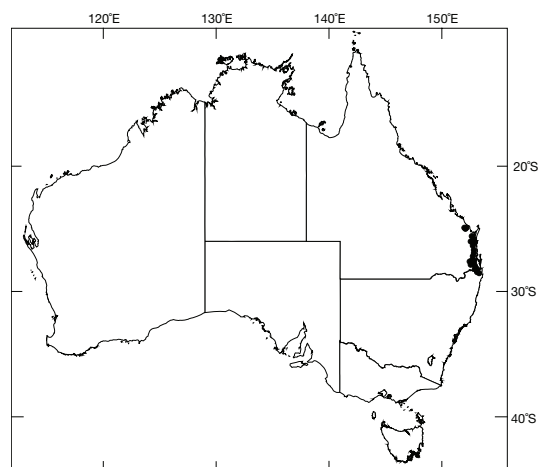
Bark: Scaly or finely fissured, brown weathering to grey-brown.

Foliage: Cotyledons—elliptic, c. 0.9×0.4 cm. Seedling—one pair of pinmate leaves (3–4 pairs of leaflets), thereafter phyllodinous, bipinnate phase absent. Adult—phyllodes, narrowly elliptic to lanceolate-elliptic, $5\text{--}12 \times 1.5\text{--}3$ cm, thinly coriaceous, margin slightly undulate, 2 or 4 prominent main nerves, minor nerves densely reticulate; gland up to 1 cm from pulvinus.

Inflorescences: Racemes, 3–6 cm long, peduncles 0.5–1 cm long, 2–4 per node, heads globular, 10 to 20-flowered, creamy yellow; flowers 4-merous, sepals free. Flowers Sept.–Oct.

Fruits: Pods, narrowly oblong, $8\text{--}20 \times 1\text{--}1.4$ cm, chartaceous, reticulate, slightly constricted between seeds. Seeds longitudinally aligned in pod, oblong to broadly elliptic, dark brown, funicle thread-like, aril absent. The seedcoat in this species is soft as seeds are reported to germinate in the pod not long after being shed from the tree. Mature Jan.–Apr.

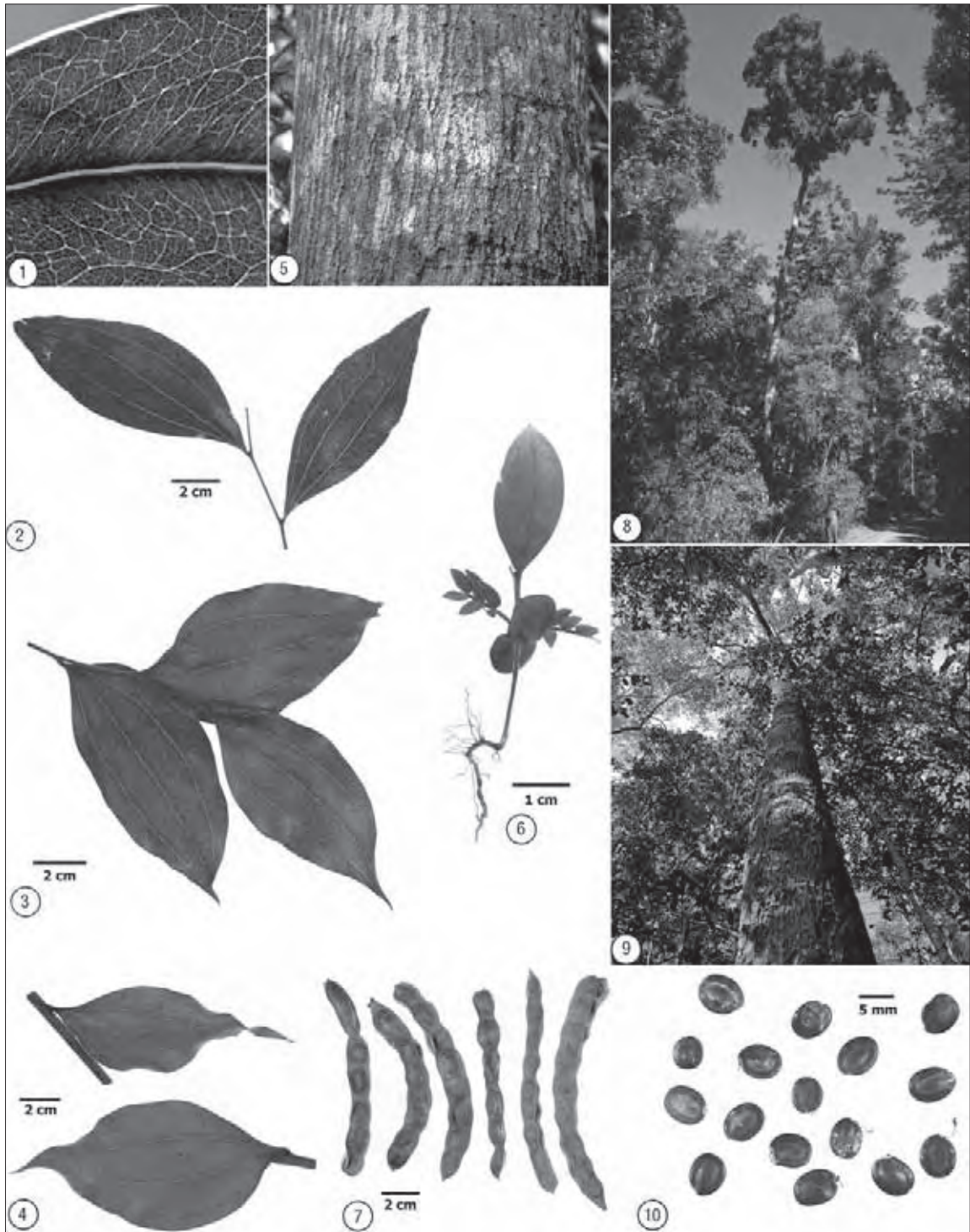
Wood: Heartwood yellowish, close-grained, hard, tough, with attractive marble-like appearance on backsawn surfaces, texture coarse and even, sapwood susceptible to *Lyctus* attack, density 895 kg m^{-3} ; in the past it was reported to be



suitable for flooring, cabinetwork, scantling, cases, wheel spokes and tool handles; availability limited.

Climate: Altitudinal range: 5–200 m; Hottest/coldest months: 30–31°C/6–12°C; Frost incidence: low; Rainfall: 1150–1700 mm per year, summer max.

Distinctive features: A large tree with a limited occurrence, associated with subtropical rainforests; phyllodes to 12 cm long and 3 cm wide, with 2 or 4 prominent main nerves, densely reticulate minor nerves and undulate margins; inflorescences in racemes up to 6 cm long; flowers 4-merous; pods to 20 cm long; seed coat soft.



Acacia bakeri 1. Adult phyllode nervation 2. Juvenile phyllodes 3. Adult phyllodes 4. Adult phyllodes with pronounced 'drip tip' 5. Bark 6. Seedling 7. Pods 8, 9. Trees, near Gympie, Qld 10. Seeds

Gidgee Stinking Wattle, Gidyea, Gidya

Acacia cambagei R.T. Baker

Gidgee is a small to medium-sized tree, 10–12 m tall, with boles up to 30 cm dbh. It either divides into a few main stems at ground level or forms a single trunk. The crown is usually densely foliated and may be equal in width to the height of the tree.

This is a common widespread species throughout the greater Lake Eyre and upper Murray–Darling drainage basins. It extends from Broken Hill in western New South Wales, north to near the Gulf of Carpentaria in north Queensland and from the Alice Springs area in central Australia, east to within 150 km of the east coast of Queensland. It is particularly common in central Queensland. It is replaced by its close relative *A. georginae* in the Georgina River drainage basin in Northern Territory.

Gidgee grows on plains and gently undulating terrain with limited extension to the slopes of low hills and ridges. Soils range from clay loams to fine textured alluvials but it is most commonly found on grey or brown cracking clays. The alluvial soils are derived from sedimentary or volcanic rocks.

Gidgee often forms pure stands, particularly in the more arid parts of its range. These occur as low woodlands in linear groves along drainage lines. In higher rainfall areas, where it grows in woodlands or open forests, it may be associated with a wide range of species such as rosewood (*Heterodendrum oleifolium*), Coowara box (*Eucalyptus cambageana*), coolibah (*E. coolabah*), poplar box (*E. populnea*) and belah (*Casuarina cristata*).

Related species: Gidgee (sect. *Plurinerves*) is closely related to Georgina gidgee (*A. georginae*), a tropical species that occurs in western parts of the Georgina River catchment mainly in Northern Territory. It mainly differs in having broader, strongly curved pods and phyllodes that contain fluoroacetic acid, which is extremely poisonous to stock.

Publication: *Proc. Linn. Soc. New South Wales* 25, 661; pl. 42 (1901). Type: Bourke, New South Wales, May 1900, R.H. Cambage.

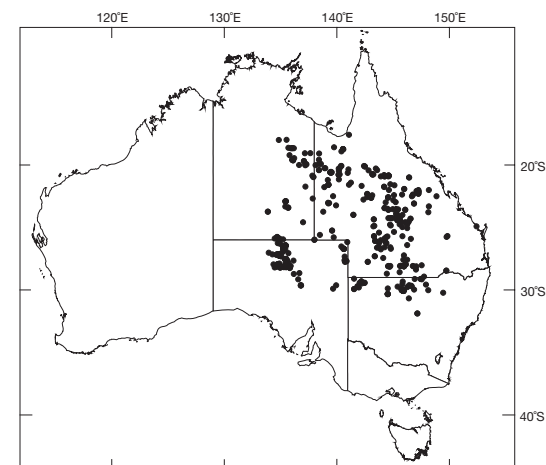
Names: Botanical—named after R.H. Cambage (1859–1928) a Chief Mining Warden of New South Wales who had a strong interest in botany. Common—of Aboriginal origin.

Bark: Rough, deeply furrowed, hard, fracturing in linear flakes, dark grey-brown to grey.

Foliage: Seedling—first two leaves pinnate with 6 leaflet pairs, thereafter phyllodinous, bipinnate phase absent. Adult—phyllodes, narrowly elliptic to linear-elliptic, narrowed at both ends, 4–14 × 0.3–1.5 cm, leathery, 1–3 nerves more evident, minor nerves numerous, obscure, closely parallel.

Inflorescences: Racemes, 4 to 20-headed, 0.2–0.3 cm long, minutely hairy; peduncles 0.4–1 cm long, heads globular, 12 to 25-flowered, golden; flowers 5-merous, sepals free to partially fused. Depending on seasonal conditions flowering may occur May–Sept.

Fruits: Pods, narrowly oblong, 7–13 × 0.8–1.2 cm, papery, surface coarsely reticulate. Seeds longitudinally aligned in

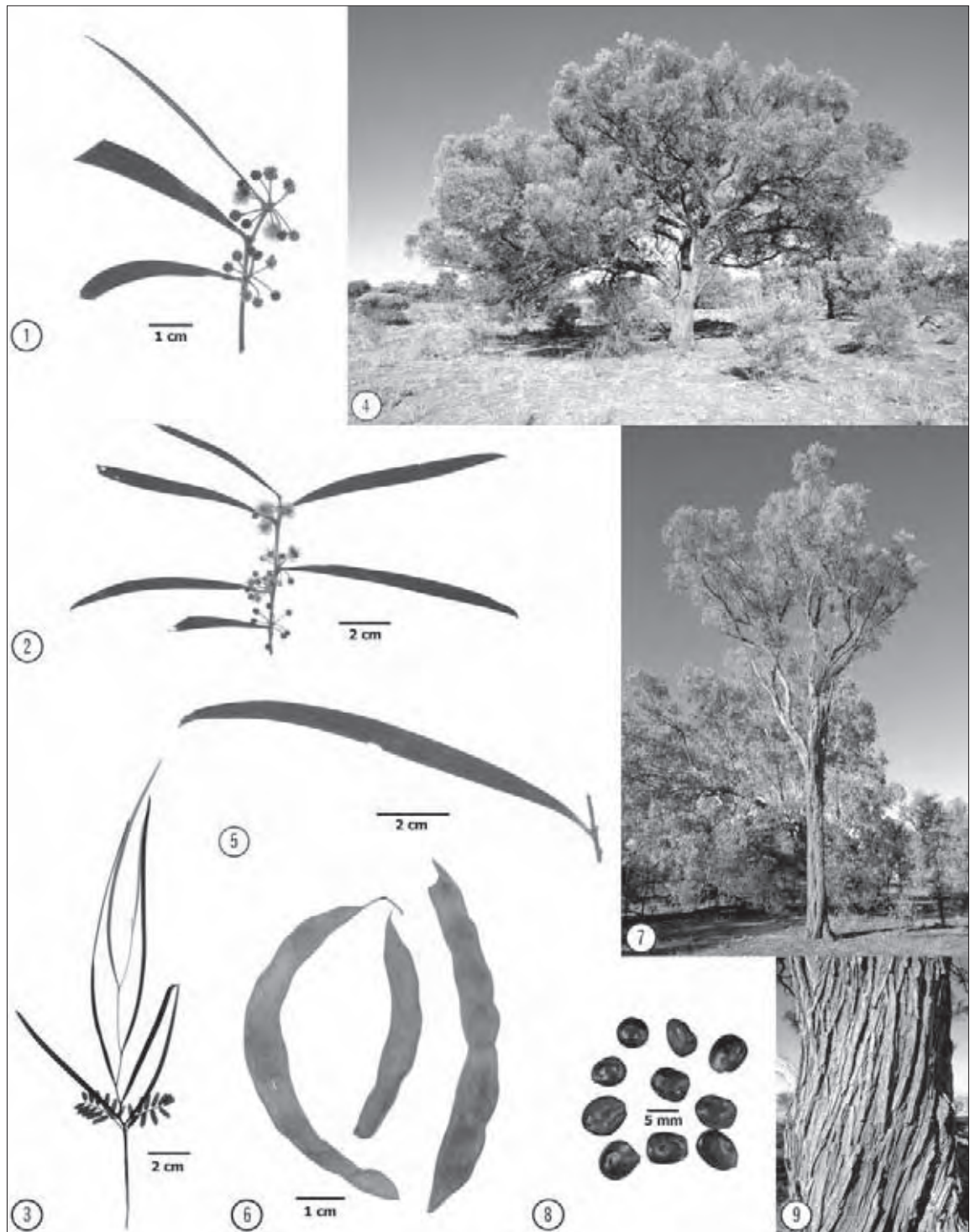


pod, broadly elliptic to oblong, flattened, soft, dull, dark brown, funicle short, aril obscure. Mature Sept.–Nov.

Wood: Sapwood pale yellow, heartwood dark reddish brown to sometimes nearly black, hard, very heavy, durable in the ground, fine-textured, occasional marked figure resulting from grain running in short waves (known as ‘ringed gidgee’) and very dense, density 1260–1345 kg m⁻³; turns well and takes on a high polish, highly regarded as firewood as it produces intense heat; used for fence posts.

Climate: Altitudinal range: 75–500 m; Hottest/coldest month: 36–40°C/4–10°C; Frost incidence: low to moderate (1–5 per year); Rainfall: 250–900 mm per year, summer max. to uniform in the south of its range.

Distinctive features: Small stout tree usually found on cracking clay soils with rough, grey, furrowed bark that fractures in linear flakes and leathery dull green to light grey foliage; the foliage produces an unpleasant foetid smell, especially during humid conditions.



Acacia cambagei 1. Inflorescences 2. Adult phyllodes and inflorescences 3. Seedling 4. Tree, Huckita Station, N.T. 5. Adult phyllode 6. Pods 7. Tree, Wards River, Qld 8. Seeds 9. Bark

Brown Salwood

Acacia celsa Tindale

Brown salwood is a tall tree up to 30 m in height and with a dbh up to 80 cm or sometimes greater. The crown is usually compact with dense, grey-green foliage. Bole form is variable and may be unbranched for up to 10 m or divide into two or three stems from 1 m above ground level; dbh may be up to 1 m.

This species has an ecologically restricted occurrence in north-eastern Queensland, extending from south of Cooktown to near Tully. Its westernmost occurrence is on the eastern portion of the Atherton Tableland and a southern outlier occurs at Paluma Range, north-west of Townsville.

Brown salwood is a pioneer or canopy species associated with rainforests of the wet tropics. Topography ranges from narrow coastal plains, steep mountains to gently undulating terrain. Soils are slightly acidic and mainly reddish or red-brown, clays or loamy clays derived from granite, metamorphic rocks or alluvia.

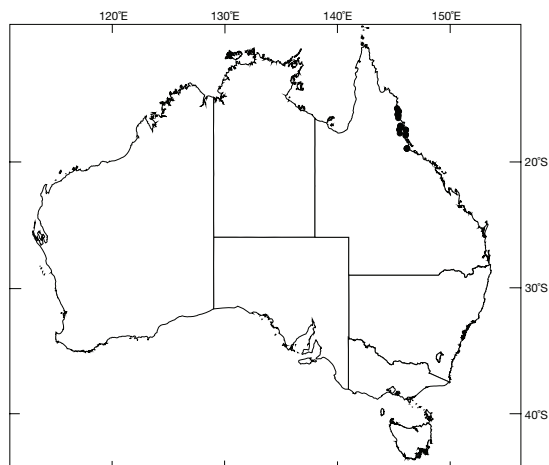
Brown salwood grows in open or tall open forests and in or near closed rainforests. Commonly associated species include other salwoods (*A. crassicarpa*, *A. mangium*), red wattle (*A. flavescens*), *A. polystachya*, large-fruited red mahogany (*E. pellita*), forest red gum (*E. tereticornis*) and numerous rainforest species endemic to the region.

Related species: Brown salwood (sect. *Juliflorae*) is a member of the '*A. aulacocarpa* group'. McDonald and Maslin (2000) revised this group and found the name *A. aulacocarpa* to be widely misapplied. Typical *A. aulacocarpa* (syn. *A. aulacocarpa* var. *fruticosa*) is a relatively uncommon species that extends sporadically from far northern coastal New South Wales and south-eastern Queensland, north to the Atherton Tableland region. *Acacia lamprocarpa* was reinstated for the northern Australian taxon previously considered to represent *A. aulacocarpa* from western Queensland, Northern Territory and the Kimberley region of Western Australia. Including *A. celsa*, five new taxa were recognised, *A. disparrima* subsp. *disparrima* (northern New South Wales and Queensland), *A. disparrima* subsp. *calidestris* (north Queensland), *A. midgleyi* (far north Queensland) and *A. peregrinalis* (New Guinea). Brown salwood is most closely allied to typical *A. aulacocarpa* and *A. disparrima*. It differs from these species by the number of spikes per axil (4–8), the curved, woody pods with undulate dorsal margins and by its compressed, ovoid seeds that have a greyish cream aril. It is also a much larger tree, associated with rainforests in the wet tropics.

Publication: *Aust. Sys. Bot.* 13, 21–78 (2000). Type: 5 km E along Mission Beach turn-off from Bruce Highway, Queensland, 4 Oct. 1996, M.W. McDonald 2175 & P.A. Butcher.

Names: Botanical—Latin *celsus* (high, lofty), in reference to its tall stature. Common—probably alludes to the brown colour of the heartwood and its similarity to Sal (*Shorea robusta*).

Bark: Hard, thin, very shallowly furrowed, brown weathering to grey.



Foliage: Cotyledons—oblong, elliptic, 5–7 mm long. Seedling—first leaf pinnate, second leaf bipinnate, at the third or fourth leaf stage the petiole elongates and flattens and a bipinnate leaf persists at the apex, thereafter phyllodinous. Adult—phyllodes, dimidiate to subfalcate, broadest at or just above middle, 5–15.5 × 1.5–2.5 cm, thinly coriaceous, glabrous, longitudinal nerves numerous and parallel with 3–8 more prominent than the rest, minor nerves not anastomosing, very close together, all nerves basally confluent and contiguous with the lower margin for a short distance above the pulvinus.

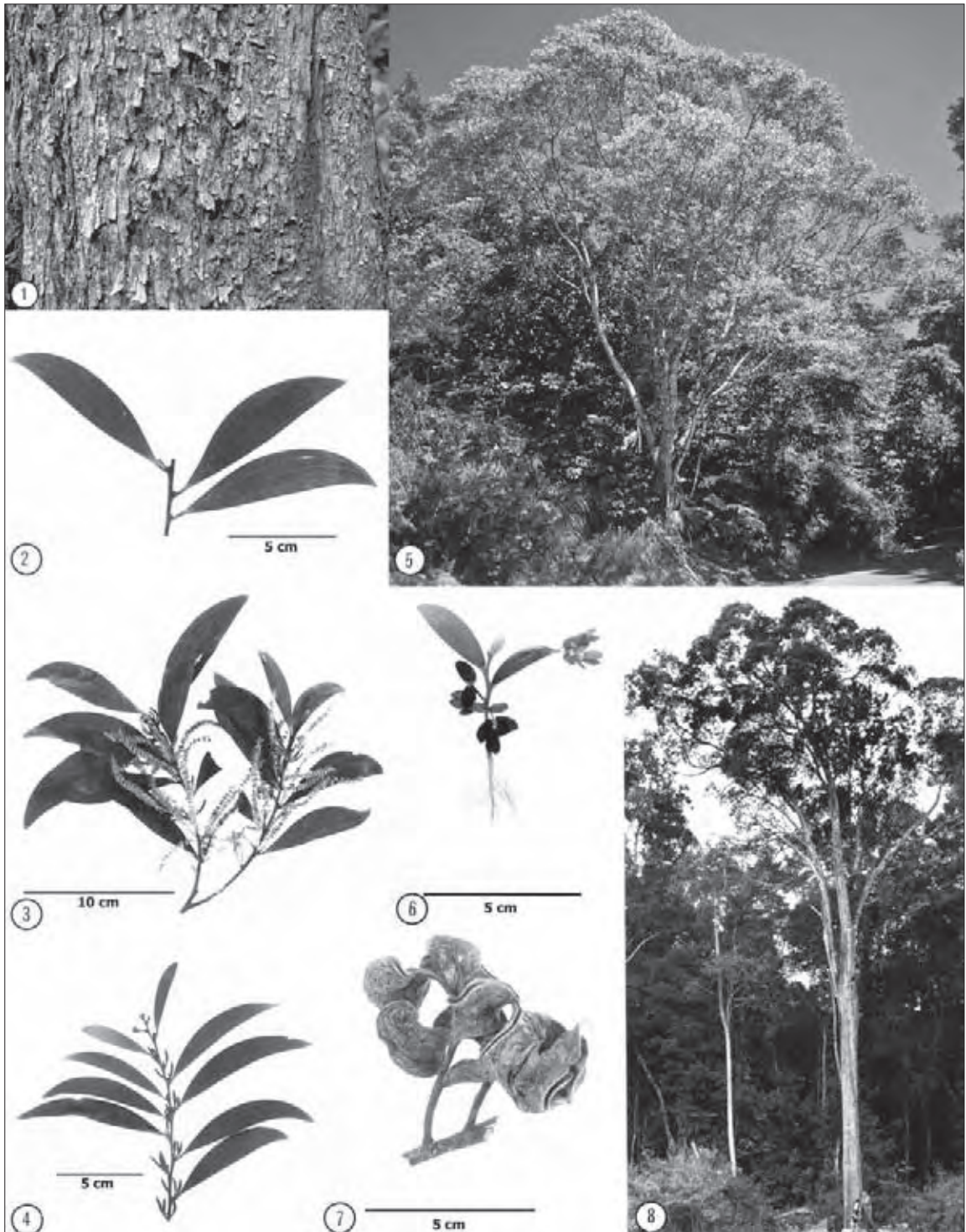
Inflorescences: Simple, axillary spikes, 4–8 per axil, spikes 3–6 cm long, pale lemon yellow, flowers subdensely arranged along rachis; flowers 5–merous, sepals partially fused. Flowers Jan.–May.

Fruits: Pods, oblong to narrowly oblong, undulate, moderately to strongly curved, 2–5 × 1.5–2 cm, dehiscing along dorsal suture, woody, with prominent transverse reticulate nervation. Seeds oblique to transversely aligned in pod, more or less ovoid, compressed, glossy, brown to black, funicle-aril with 4–6 folds, greyish cream. Mature Oct.–Jan.

Wood: Sapwood susceptible to *Lyctus* attack; heartwood light brown, hard, tough, strong, durable, density about 690 kg m⁻³. The wood bends, glues and seasons well. When available the timber is used for framing, weatherboards and joinery.

Climate: Altitudinal range: near sea level to 750 m; Hottest/coldest months: 29–32°C/10–17°C; Frost incidence: low; Rainfall: 1100–3800 mm per year, summer max.

Distinctive features: Tall tree associated with rainforests in the wet tropics with a dense, compact crown of grey-green, dimidiate to subfalcate phyllodes; spikes pale lemon yellow, 4–8 per axil; pods woody, relatively large, often strongly curved, prominently reticulate, dehiscing along the dorsal suture at maturity.



Acacia celsa 1. Bark 2. Phyllodes from mature tree 3. Flowering branch 4. Branchlet with phyllodes and inflorescences at bud stage 5. Tree, near Ravenshoe, Qld 6. Seedling 7. Fruit 8. Tree, Kuranda State Forest, Qld

River Jam Milhan, Wantan, Black Mulga

Acacia citrinoviridis Tindale & Maslin

River jam is a large shrub or small tree up to 15 m in height. Maximum dbh development is in the range of 20–30 cm. The crown is many-branched and the grey-green foliage has a silvery sheen due to the presence of minute hairs.

The main occurrence is in the Pilbara region of Western Australia. It extends from the De Grey River and Marble Bar region south to the Wooramel River in the Gascoyne region. There is some extension east of the Pilbara region to near Wiluna in the northern Goldfields region.

River jam is most common near seasonally dry creeks and riverbeds. The main soil types are alluvial, red-brown sandy loams, sandy clays or loams. The most common rock substrates in the area are massive iron-stone formations.

This species grows in riparian woodlands or sometimes in open forests. Associated aborescent species include river red gum (*E. camaldulensis*), coolibah (*E. victrix*) and other wattles (*A. coriacea*, *A. trachycarpa*, *A. tetragonophylla*, *A. aneura*).

Related species: River jam (sect. *Juliflorae*) is related to Hamersley wattle (*A. hamersleyensis*), which also occurs along creeks in the Pilbara region but differs in having straighter, glabrous phyllodes, golden flower spikes and undulate pods with obliquely orientated seeds. *Acacia xanthocarpa*, which occurs further south in the Murchison region, has hairy pods reminiscent of river jam. In the field, river jam may be mistaken for *A. distans*, which also occurs near water courses in the Pilbara region. It differs in having its flowers less densely clustered along the receptacle, a receptacle with white, often sparse, appressed hairs and narrower pods (3–5 mm wide) that lack the velvety, lemon-green hairs.

Publication: *Nuytsia* 2, 86 (1976). Type: Fortescue River crossing, east of Millstream Homestead, Western Australia, 11 Jun. 1972, B.R. Maslin 2735.

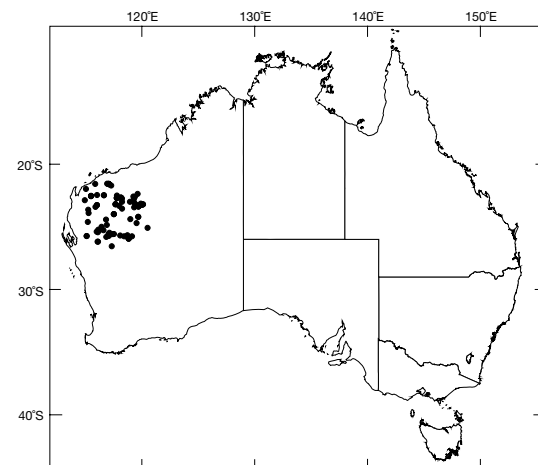
Names: Botanical—Latin *citrinus* (lemon yellow), *viridis* (green), in reference to the hairs on the new shoots and pods. Common—alludes to its superficial similarity to jam (*A. acuminata*).

Bark: Rough, fissured, dark grey.

Foliage: Cotyledons—oblong, 6–8 mm long. Seedling—first leaf pinnate, second leaf bipinnate, at the third leaf stage the petiole elongates and flattens and a bipinnate leaf persists at the apex, phyllodinous at around the fourth leaf stage. Adult—phyllodes, falcate, 8–16 × 0.4–1.3 cm, coriaceous, densely sericeous to glabrescent, midnerve prominent, most minor nerves, obscure, parallel, closely spaced, gland small. New growth has dense, yellow-green hairs.

Inflorescences: Simple, axillary spikes, 1–2 per axil, spikes 0.8–3.2 cm long, flowers densely arranged, bright yellow; flower receptacle with dense, patent, lemon-yellow hairs (view with ×10 handlens); flowers 5-merous; sepals slightly fused. Flowers Apr.–Jun.

Fruits: Pods, linear, 2.5–12 × 0.7–1.5 cm, velvety with yellow-green hairs. Seeds longitudinally aligned in pod, broadly

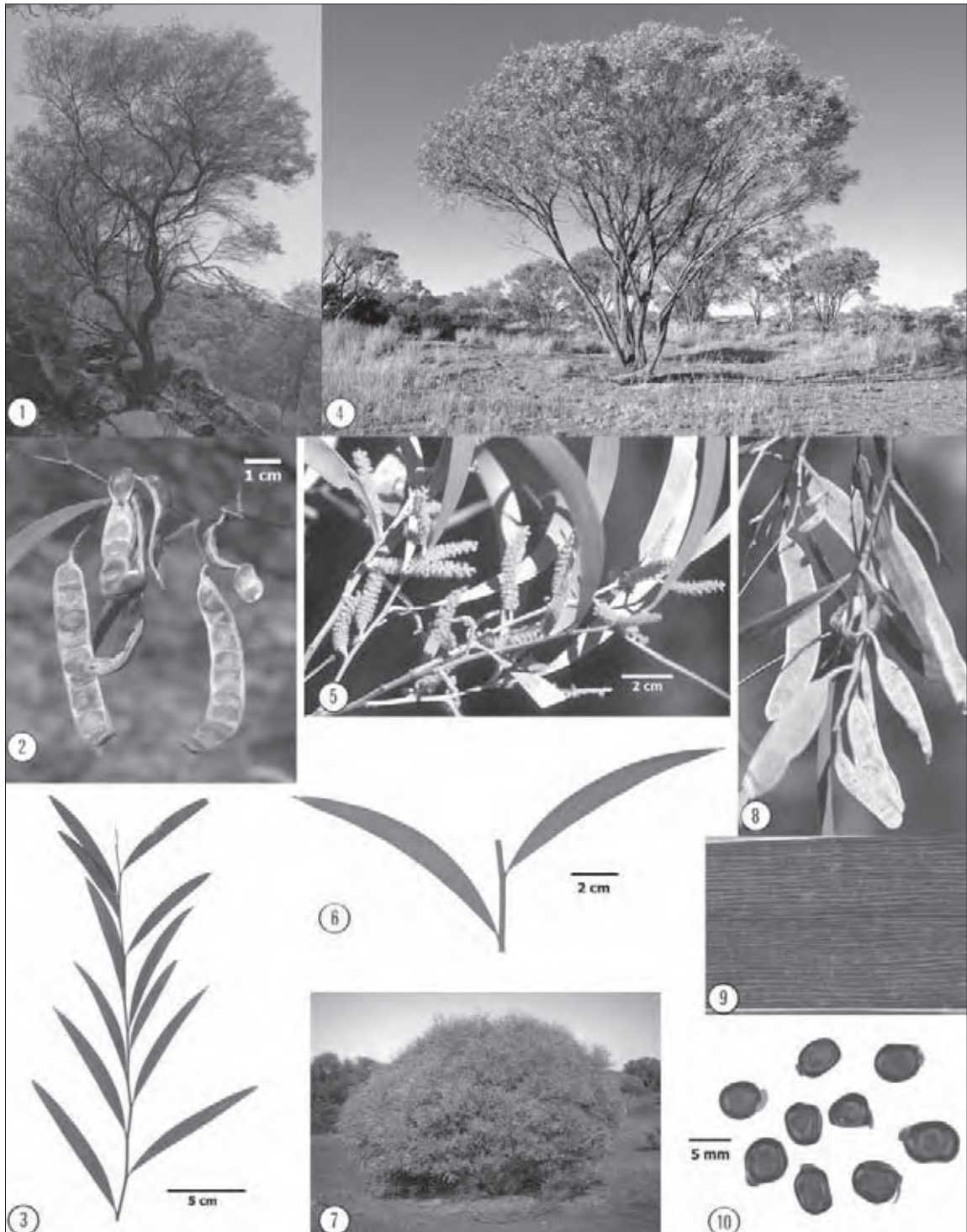


elliptic to globose, flattened, black or dark brown; funicle thin, cream-coloured. Mature Oct.–Nov.

Wood: Heartwood dark brown, density is in the range 800–900 kg m⁻³; other properties poorly known.

Climate: Altitudinal range: 150–500 m; Hottest/coldest months: 40–42°C/8–11°C; Frost incidence: low; Rainfall: 250–400 mm per year, summer max.

Distinctive features: Large shrub or tree growing in proximity to watercourses, with a crown of grey-green silvery foliage; phyllodes densely sericeous with a prominent midnerve and numerous obscure, parallel, closely spaced minor nerves; new growth has dense, yellow-green hairs; flower spikes 1–2 per axil; flower receptacle with dense, patent, lemon-yellow hairs; pods densely covered in short, erect, yellow-green hairs. Seeds were ground and eaten by Aboriginal people.



Acacia citrinovirdis 1. Tree, Hammersly Range, W.A. 2. Pods near to dehiscence 3. Seedling leaves 4. Tree, Lander River, W.A. 5. Flowering sprigs 6. Phyllodes 7. Juvenile plant 8. Densely hairy young pods 9. Phyllode nervation 10. Seeds

Thick-pod Salwood Northern Wattle

Acacia crassicarpa A. Cunn. ex Benth.

Thick-pod salwood is a tree that often reaches 20 m in height but may attain heights of 30 m on favourable sites or it may occur as a shrub less than 1 m tall on adverse sites. The bole may be up to half the tree height in length, with maximum dbh development in the range of 50–60 cm. The crown is usually dense, comprised of large, dull, broadly falcate foliage.

In Australia this species is endemic to Queensland and extends from a number of islands in the Torres Strait south to the Burdekin region. There are southern outliers near Mackay and on Whitsunday Island. Populations become less frequent with increasing distance from the coast, but populations extend to the Atherton Tableland. This species also occurs in the southern lowlands of New Guinea.

In Australia, thick-pod salwood is most common on lowland, coastal or near-coastal sites, including sandy levees near seasonally dry creeks and on coastal foredune systems. The main soil types are acidic, alluvial or colluvial sands or sandy loams. On the Atherton Tableland soil types are clay or clay loams. Rock substrates include granite, schists and volcanic types.

Thick-pod salwood occurs in open forests or woodlands or sometimes on the margins of closed rainforests. Associated species include ear-pod wattle (*A. auriculiformis*), other salwoods (*A. celsa*, *A. mangium*), red wattle (*A. flavescens*), *A. leptocarpa*, *A. polystachya*, carbeen (*E. tessellaris*), white gum (*E. platyphylla*) and swamp box (*Lophostemon suaveolens*).

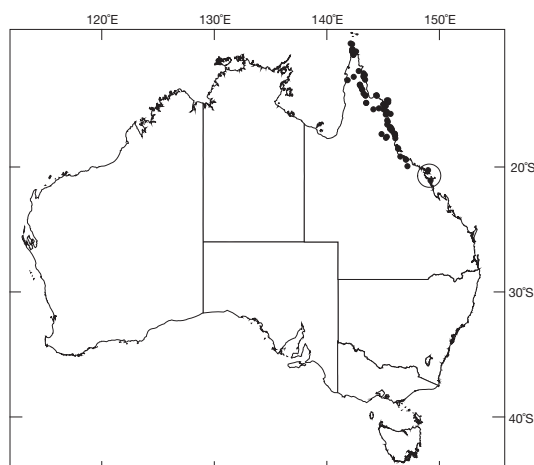
Related species: Thick-pod salwood (sect. *Juliflorae*) is a member of the '*A. aulacocarpa* group'. Within this group it belongs in a subgroup with *A. lamprocarpa*, *A. midgleyi*, *A. peregrinalis* and *A. wetarensis* (McDonald and Maslin 2000). These species are distinguished by their mode of pod dehiscence in which seed is shed via the ventral suture; other members of the *A. aulacocarpa* group shed seed via the dorsal suture. Thick-pod salwood differs from its close relatives in having larger broadly falcate phyllodes, up to 27×4.5 cm, which narrowly tapered and elongate at the base, golden-yellow flower spikes in clusters of 2–6 per axil, broader woody pods and terete seeds that have a long, many-folded aril.

Publication: *Hooker's London J. Bot.* 1, 379 (1842). Type: Lizard Island, Queensland, Aug. 1820, collected by the botanist Alan Cunningham during Phillip Parker King's voyage of the HMS *Mermaid*.

Names: Botanical—from the Latin *crassus* (thick) and the Greek *carpos* (a fruit), in reference to its woody pods. Common—salwood probably alludes to the colour of the heartwood and its similarity to Sal (*Shorea robusta*).

Bark: Rough, moderately to deeply longitudinally furrowed, brown weathering to grey.

Foliage: Cotyledons—oblong, 6–8 mm long. Seedling—first leaf pinnate, second leaf bipinnate, at the third leaf stage the petiole elongates and flattens and a bipinnate leaf persists at the apex, phyllodinous by about the fourth leaf stage. Adult—



phyllodes, broadly falcate (broadest below the middle and curved along both margins) with a long narrow taper to the base, $8\text{--}27 \times 1\text{--}4.5$ cm, glabrous, leathery, longitudinal nerves numerous and parallel, with 3–7 nerves more prominent than the rest, the minor nerves close together and non-anastomosing; gland small, basal.

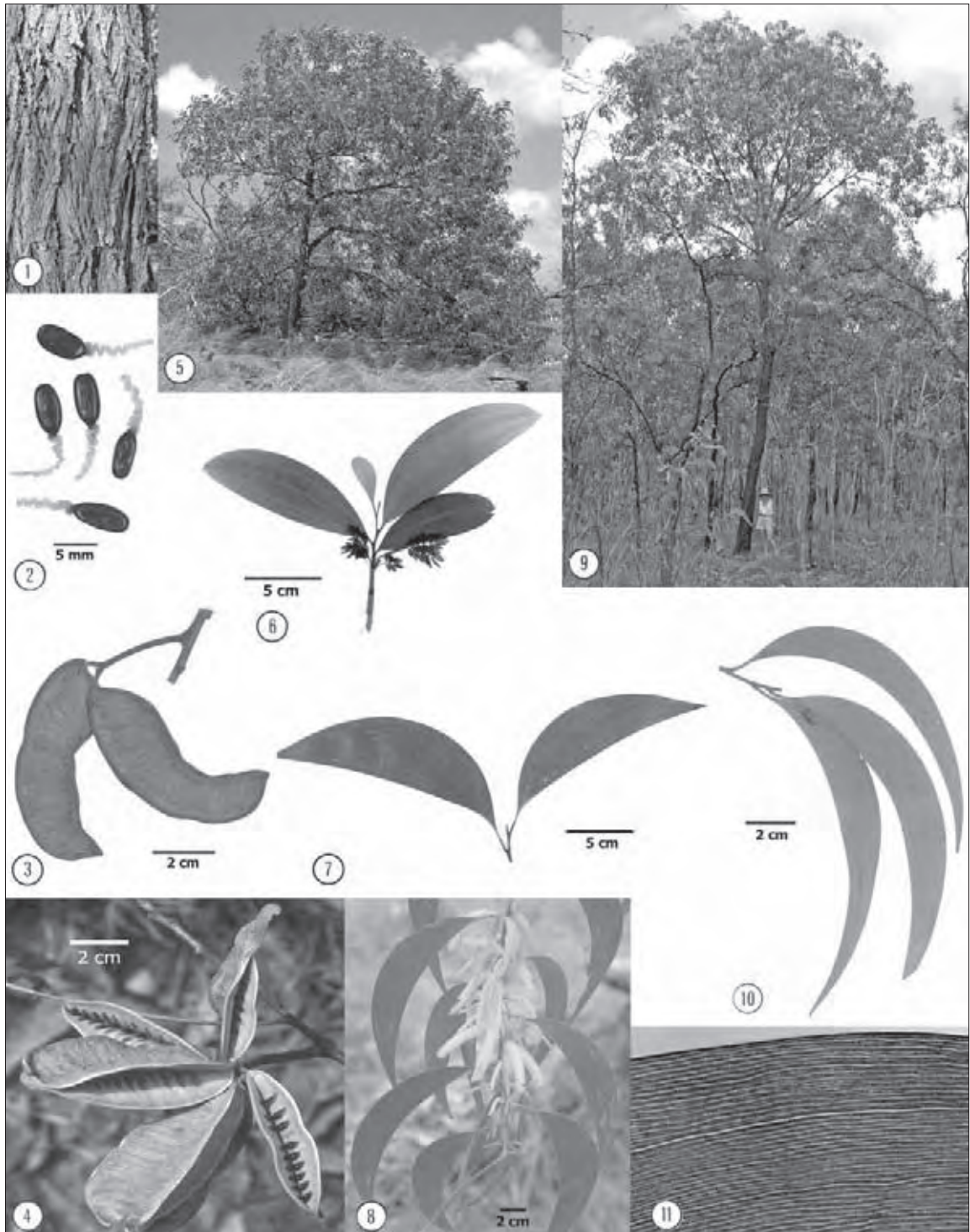
Inflorescences: Simple, axillary spikes, 2–6 per axil, up to 12 cm long, flowers subdensely arranged along rachis, light golden to pale yellow; flowers 5–merous, sepals fused. Flowers Apr.–Jun.

Fruits: Pods, oblong to narrowly oblong, flat, woody, with transverse to transversely oblique nerves, $4\text{--}12 \times 2\text{--}4.5$ cm. Seeds transversely aligned in pod, obloid to ovoid, more or less terete, glossy, black, aril cream to white, many-folded and up to 2 cm long when fully expanded. Mature Sept.–Nov.

Wood: Sapwood pale yellow-brown, heartwood reddish brown, density $500\text{--}805 \text{ kg m}^{-3}$; uses include heavy construction, furniture, flooring and veneer; plantations for pulp wood production have been established in South-East Asia by the paper pulp industry.

Climate: Altitudinal range: mainly near sea level to 150 m but up to 700 m on the Atherton Tableland; Hottest/coldest months: $32\text{--}34^\circ\text{C}/17\text{--}21^\circ\text{C}$; Frost incidence: low (except sites on the Atherton Tableland); Rainfall: 800–3600 mm per year, summer max.

Distinctive features: Tree with a dense crown of large, dull, grey-green, broadly falcate foliage; large phyllodes which taper narrowly at the base, with 3–7 prominent longitudinal nerves and numerous, parallel, closely spaced, non-anastomosing minor nerves; 2–6 spikes per axil, up to 12 cm long; thick and woody pods which dehisce seed from the ventral suture; seeds terete with a long, many-folded aril.



Acacia crassicarpa 1. Bark 2. Seeds 3, 4. Pods 5. Tree, Lizard Island, Qld 6. Seedling 7. Intermediate phyllodes 8. Flowering sprig 9. Tree, Merluna Station, Qld 10. Adult phyllodes 11. Phyllode nervation

Creekline Miniritchie Red Mulga

Acacia cyperophylla F. Muell. ex Benth.

Creekline miniritchie is a small tree 5–7 m tall but sometimes attains up to 12 m in height. Branching may occur near to ground level or it may have a bole up to 2 m. Maximum dbh development is about 30 cm. The crown is many-branched and the grey-green foliage is usually erect or sometimes pendulous. Its most notable feature is the orange or reddish bark that has short, narrow shavings, which curl back to form a ‘hairy’ appearance. Two varieties are recognised, the typical variant and var. *omearana*.

Variety *cyperophylla* occurs in two widely disjunct areas. Its eastern occurrence extends from the Winton–Windorah region of south-western Queensland east into south-eastern Northern Territory and northern and north-eastern South Australia. Its western occurrence is in the Gascoyne and Gibson Desert regions of Western Australia. Var. *omearana* occurs in two populations in the Pilbara region of Western Australia.

Creekline miniritchie occurs along seasonally dry creeks and riverbeds or sometimes at the base of breakaways. The watercourses are usually diffuse and overlain with sandy or stony alluvia. Soils are alluvial often with a reddish sandy loam surface but a clayey subsoil, derived from a range of rock types.

This species grows in low open woodlands either in pure stands or is associated with species such as river red gum (*E. camaldulensis*), coolibah (*E. coolabah*), dead finish (*A. tetragonophylla*), Georgina gidgee (*A. georginae*) and mulga (*A. aneura*).

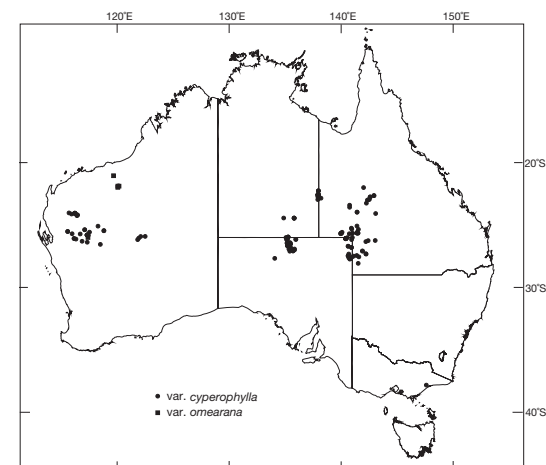
Related species: Creekline miniritchie (sect. *Juliflorae*) is related to a number of other species in the ‘miniritchie group’ that include *A. curranii*, *A. drummondii*, *A. grasbyi* and *A. rhodophloia*. These species share an array of unusual character states including the reddish, curling bark, after which they are named. Its closest relative is an undescribed taxon from Spear Hill in the Pilbara region of Western Australia (B.R. Maslin, Western Australian Herbarium, pers. comm.). It differs in having terete seedling foliage and occurring at the base of granitic rock outcrops.

Publication: Var. *cyperophylla* *Fl. Austral.* 2, 400 (1864). Type: Cooper’s Creek, South Australia, 1858, A.C. Gregory. Var. *omearana* Maslin: *w. Austral. Naturalist* 18: 186 (1991).

Names: Botanical—Greek *kypeiros* (a sedge), *phyllon* (a leaf), alluding to the phyllodes resembling a sedge leaf. Common—miniritchie is of Aboriginal origin and creekline refers to its habitat.

Bark: Minni Ritchi; a short basal stocking of grey and finely fissured bark, above bark is smooth, orange-brown to reddish brown, covered in short, narrow shavings, which curl back to form a ‘hairy’ appearance and are sometimes interspersed with patches of grey, finely fissured bark.

Foliage: Seedling—first leaf pinnate, second leaf bipinnate, soon after phyllodinous. Juvenile—phyllodes, flat, 0.2–0.3 cm wide. Adult—phyllodes, straight or gently curved, more or less terete to flat, apex pungent, 8–20 × 0.1–0.2 cm, coriaceous,



slightly minutely hairy, nerves numerous, obscure, closely spaced, parallel, gland small.

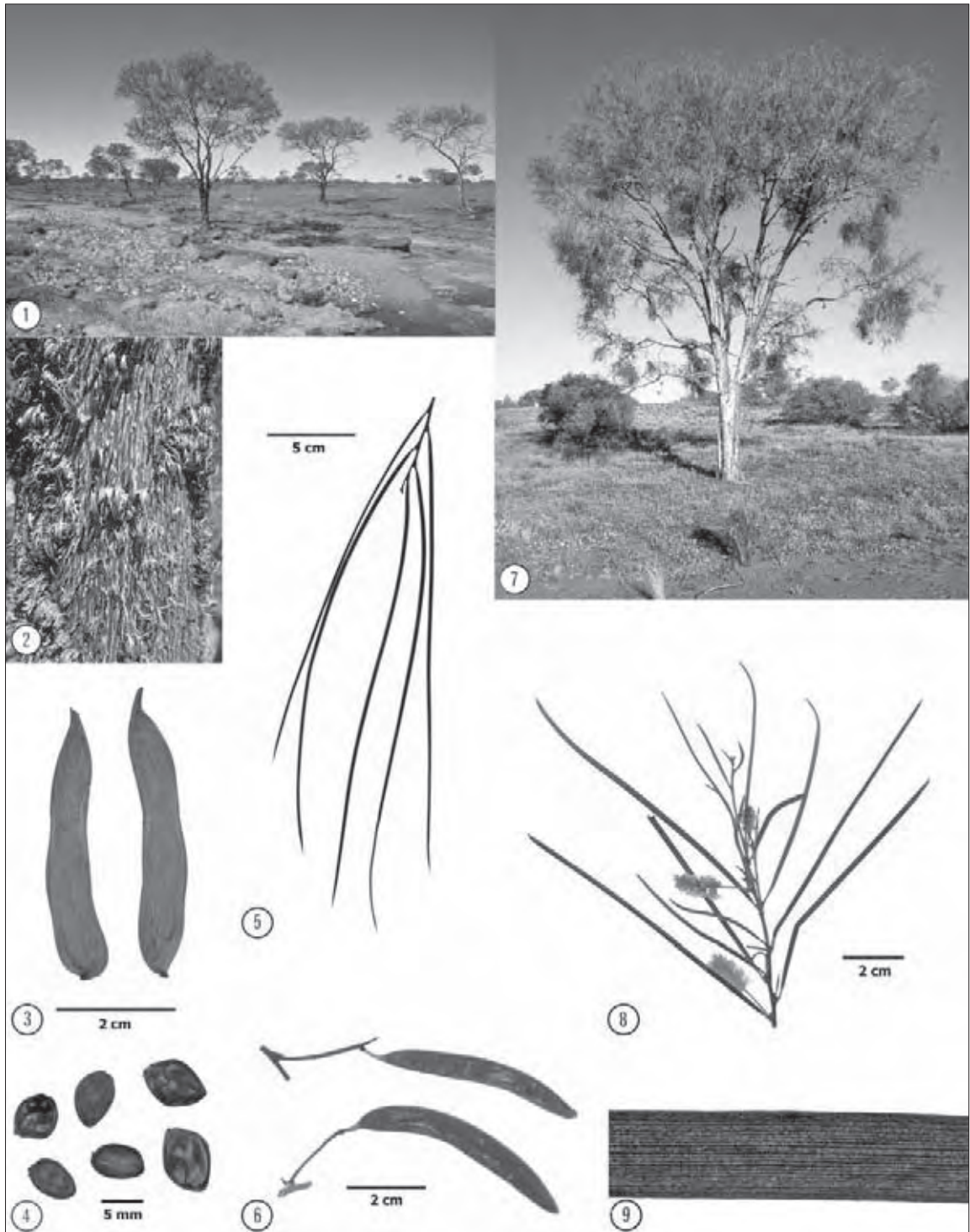
Inflorescences: Simple, axillary spikes, 1–2 per axil, spikes 1–3 cm long, flowers subdensely arranged along rachis, pale yellow; flowers 5-merous, sepals partially fused. Flowering is irregular, usually after rain.

Fruits: Pods, narrowly oblong to linear, 4–16 × 0.6–0.7 cm, subwoody, with reticulate longitudinal nerves. Seeds longitudinal to obliquely aligned in pod, more or less elliptic, the seed coat forms a narrow flange that encircles the edge of the seed, funicle thin, aril obscure. Mature pods have been collected during Sept.–Oct.

Wood: Heartwood dark brown, very hard, properties poorly known, density probably around 1200 kg m⁻³; reported to be excellent firewood.

Climate: Altitudinal range: 50–500 m; Hottest/coldest months: 39–40°C/6–9°C; Frost incidence: low to moderate; Rainfall: 150–290 mm per year, sporadic but slight summer max.

Distinctive features: Usually a tree growing along seasonally dry watercourses, with mainly smooth, orange-brown to reddish brown bark, covered in short, narrow shavings, which curl back to form a ‘hairy’ appearance; mature phyllodes narrow, terete or flat with numerous, obscure, parallel, closely spaced nerves, apex pungent; flower spikes 1–2 per axil; pods long, 0.6–0.7 cm wide, seed coat forms a narrow wing that encircles the edge of the seed.



Acacia cyperophylla 1. Stand, near Mt Augustus, W.A. 2. Bark 3. Mature pods 4. Seeds 5. Adult phyllodes 6. Maturing pods 7. Tree, Simpson Desert, S.A. 8. Inflorescences and maturing phyllodes 9. Phyllode nervation

Silver Wattle

Acacia dealbata Link

Silver wattle is commonly a large shrub or medium-sized tree in the height range 6–15 m, with an erect main stem and, wherever there is sufficient space, a well-developed conical or rounded crown. In Tasmania and Victoria, the species attains heights of 25–28 m. There are two subspecies, the typical and subsp. *subalpina*.

Silver wattle grows on the tablelands and foothills of the Australian Alps from northern New South Wales to mid-western Victoria and in Tasmania. Subsp. *subalpina* occurs mainly at higher altitudes from the Brindabella Range in Australian Capital Territory and Braidwood in New South Wales south-east to Mount Disappointment in Victoria.

The topography varies from high plateaux to deep mountain valleys, especially along stream banks. Parent rocks are varied with granite common on the tablelands, but silver wattle also grows on sandstone and, to a lesser extent, on volcanic types. Moderately deep and fertile forest loams are suitable for good growth, but the species will tolerate clays and gravelly clays if there is adequate soil drainage.

Silver wattle grows mainly in open or tall open forests, and the largest specimens are nearly always found in sheltered sites of the latter. As a small shrub it may extend to low vegetation on sandstone ridges. Associated eucalypts include brown barrel (*E. fastigata*), mountain ash (*E. regnans*), alpine ash (*E. delegatensis*) and manna gum (*E. viminalis*), while on somewhat poor sites at high altitudes there may be narrow-leaved peppermint (*E. radiata* subsp. *robertsonii*) and in both poorer and drier sites broad-leaved peppermint (*E. dives*) and long-leaved box (*E. nortonii*).

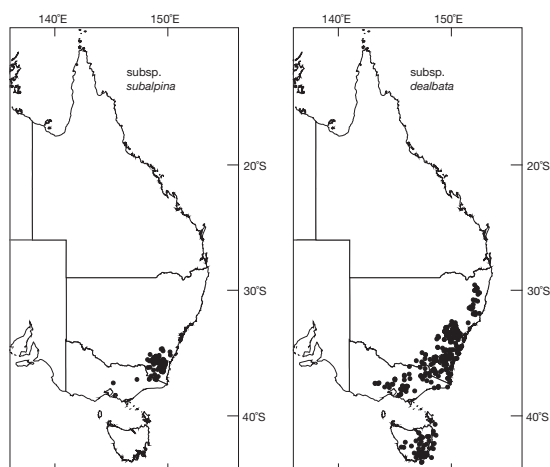
Related species: Silver wattle (sect. *Botrycephalae*) is similar to a number of other bipinnate acacias. *Acacia nano-dealbata*, which is found only in Victoria, differs by its shorter pinnules and in having a petiolar gland. Northern silver wattle (*A. leucoclada*) has smaller and more inconspicuous leaf glands and glands occurring between at least some pairs of pinnae. Bodalla silver wattle (*A. silvestris*) has larger pinnules, larger jugary glands and appressed, rather than spreading, hairs.

Publication: Subsp. *dealbata*: *Enum. Hort. Berol.* 2, 445 (1822). Type: From a cultivated plant in Berlin, Germany. Subsp. *subalpina* Kodala & Tindale: *Telopea* 9, 319 (2001). Type: Tinderry Mountains, 13.2 km ESE of Michelago, New South Wales, 2 Aug. 1975, R.G. Coveny 6599, P.D. Hind & M. Parris.

Names: Botanical—Latin *dealbatus* (covered with a white powder), the branchlets and pods and sometimes branches are pruinose. Common—refers to the silvery foliage.

Bark: Brownish black, hard and moderately fissured at the base of old trunks, but on young stems and the upper parts of old trees it is thinner, smoother and lighter in colour.

Foliage: Seedling—bipinnate, mainly with 3–5 pairs of pinnae and 7–30 pairs of leaflets; leaflets, almost sessile, oblong (but



with ends slightly pointed), about $0.5\text{--}0.8 \times 0.15$ cm. Adult—bipinnate, 6–10 cm long with 10–25 pairs of pinnae and 17–50 pairs of leaflets; the latter $2\text{--}5 \times 0.4\text{--}0.7$ mm, sparingly to somewhat densely pubescent and usually distinctly silvery-grey.

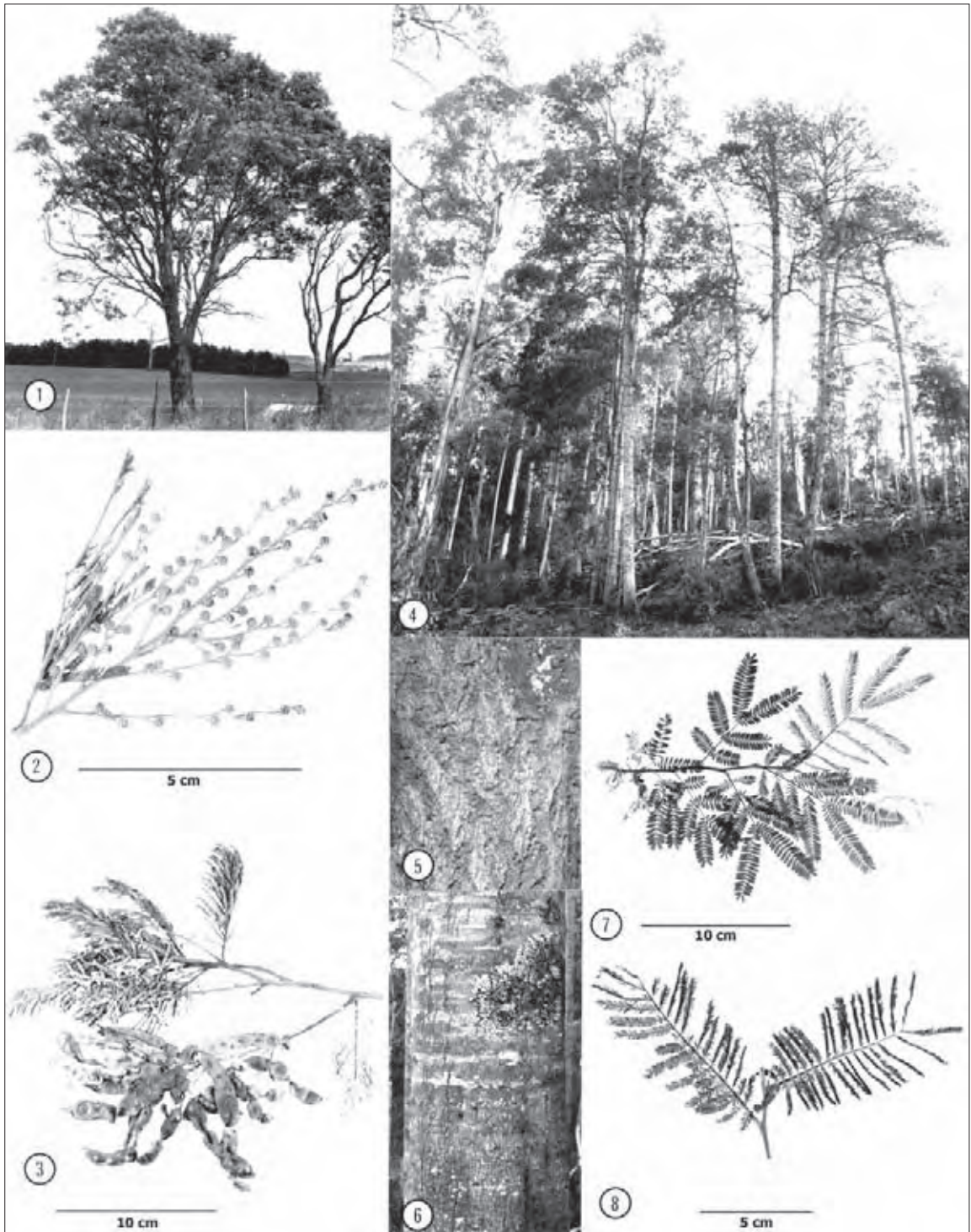
Inflorescences: Axillary racemes or terminal or axillary panicles, length about the same as the leaves, heads 13–42 flowered, bright yellow; flowers 5-merous, sepals fused. Flowers Aug.–Oct.

Fruits: Pods, narrowly oblong, straight or slightly curved, $3\text{--}8 \times 0.7\text{--}1.3$ cm, pruinose. Seeds longitudinally aligned, ellipsoid, dull, black; funicle short, aril small, cream. Mature Nov.–Jan.

Wood: Sapwood susceptible to *Lyctus* attack; heartwood varies from pale brown to pinkish with streaks, density $460\text{--}1000\text{ kg m}^{-3}$. Compared with many other acacias the wood is a rather poor fuel. The wood has good glueing and pulping properties; it is used for pulp production in Tasmania and Victoria and has potential as a furniture wood and for panelling. In the past it was used for clothes pegs and shoe heels.

Climate: Altitudinal range: 50–1000 m; Hottest/coldest months: $20\text{--}28^\circ\text{C}/-1\text{--}2^\circ\text{C}$; Frost incidence: high; Rainfall: 600–1500 mm per year, mainly uniform to winter max.

Distinctive features: Bipinnate foliage, usually silvered with minute white hairs, especially at the tips. Silver wattle is referred to as ‘mimosa’ in southern Europe and is cultivated for decorative use as winter flowers and for an oil extracted from the flowers to make perfume.



Acacia dealbata subsp. *dealbata* 1. Tree, near Oberon, N.S.W. 2. Floral buds 3. Fruiting branch 4. Stand, near Bendoc, Vic. 5, 6. Bark variation 7. Seedling 8. Adult leaves

Green Wattle Early Black Wattle, Wattah

Acacia decurrens Willd.

Green wattle is a medium-sized tree up to 15 m in height but sometimes reported to attain up to 22 m in height. Maximum dbh development is around 50 cm. It is commonly a single-stemmed tree with a straight trunk, which may be up to half the tree height. The crown comprises lateral to ascending branches, which may be up to 8 m across on largest specimens. Crown foliage is usually a bright green.

This species is endemic to New South Wales where it occurs mainly on coastal hinterlands, subcoastal ranges and tablelands. It extends from the Hunter Valley south to the Tarago area near Goulburn and Ulladulla on the south coast. It has become naturalised in many parts of south-eastern Australia from south-eastern Queensland south to Tasmania, South Australia and south-western Western Australia.

Green wattle grows in a range of habitats including along gullies, hillsides and creekbanks. The soils range from deep to skeletal, free-draining light to medium clays, clay loams and sandy loams. They may be derived from shale, sandstone, metasediments or basalt.

Green wattle grows in open forests and woodlands. There is a range of associated species including manna gum (*E.viminalis*), silvertop ash (*E. sieberi*), yellow box (*E. melliodora*), red box (*E. polyanthemos*), broad-leaved peppermint (*E. dives*) and other wattles such as Parramatta wattle (*A. parramattensis*) and black wattle (*A. mearnsii*).

Related species: Green wattle (sect. *Botrycephalae*) is related to *A. dangarensis*, which is restricted to Mt Dangar near Musselbrook, New South Wales, and mainly differs in having terete branchlets and narrower leaflets.

Publication: *Sp. Pl.* 4th edn, 4, 1072 (1806). Type: 'Habitat in Nova Hollandia'.

Names: Botanical—Latin *decurrens* (running down), alluding to the ridges on branchlets which run down from the base of the leaves. Common—presumably refers to the green foliage.

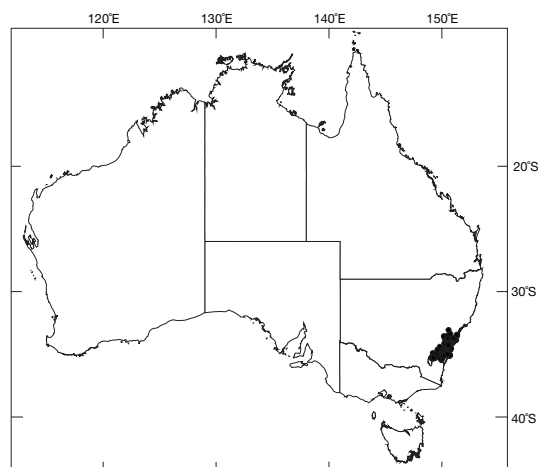
Bark: Fissured, brown to dark grey, smooth grey above; tannin content high.

Foliage: Cotyledons—sessile, oblong, c. 5 mm long.

Seedling—first leaf pinnate with 3–4 oblong leaflets, leaves 2–5 bipinnate with one pair of pinnae (with 5–10 pairs of oblong leaflets), thereafter number of pinnae per leaf and number of leaflet pair per pinnae increases; branchlets clearly ridged. Adult—bipinnate, rachis up to 12 cm long, angular, furrowed, jugary glands at all pairs of pinnae, 3–13 pairs pinnae, 2.5–9 cm long, pinnules in 15–45 pairs, widely spaced, 5–15 × 0.4–0.8 mm, normally glabrous, green above. Branchlets have conspicuous winged ridges that extend from the base of the leaves.

Inflorescences: Axillary racemes or terminal panicles, about as long as the leaf, heads 20 to 32-flowered, golden; flowers 5-merous, sepals fused. Flowers Jul.–Nov.

Fruits: Pods, narrowly oblong, slightly constricted between seeds, 2–11 × 0.5–0.9 cm, chartaceous to coriaceous, margins

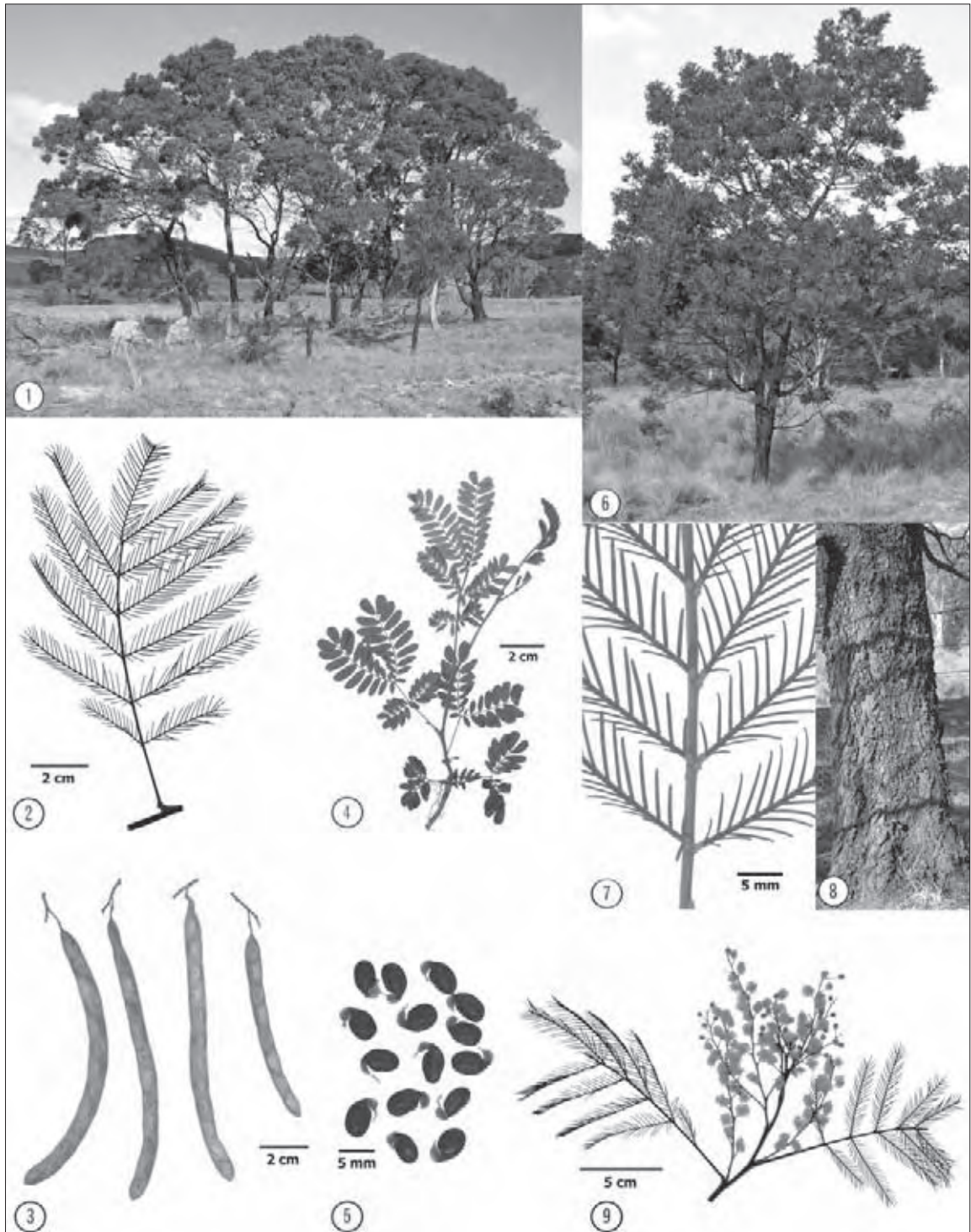


thickened. Seeds longitudinally aligned in pod, ellipsoid, black, aril white, small. Mature Nov.–Jan.

Wood: Sapwood whitish, heartwood pale brown, density 720 kg m⁻³; used overseas as a source of firewood, building poles, mine props and fence posts; also reported to have good properties for paper pulp production.

Climate: Altitudinal range: 25–1000 m; Hottest/coldest month: 26–30°C/1–5°C; Frost incidence: moderate (up to 25 per year at the coolest part of the range); Rainfall: 650–1150 mm per year, uniform.

Distinctive features: Tree with green bipinnate foliage; branchlets with conspicuous winged ridges running along the stem from the base of the leaves; leaflets linear, narrow and widely spaced; inflorescences axillary or terminal panicles, heads golden; pods narrowly oblong, with thickened margins. Grown for its bark as a source of tannin to produce fibreboard in South Africa.



Acacia decurrens 1. Stand, near Currawong, N.S.W. 2. Adult leaf 3. Pods 4. Seedling 5. Seeds 6. Tree, near Currawong, N.S.W. 7. Detail of leaf rachis showing glands 8. Bark 9. Inflorescences on leafy shoot

Cedar Wattle Mountain Cedar Wattle

Acacia elata A.Cunn. ex Benth.

Cedar wattle is a medium-sized tree commonly up to 15 m tall but sometimes may attain heights up to 25 m. Maximum dbh development on largest trees is 90 cm. The trunk is often well developed and the crown foliage dense. The crown comprises numerous lateral branches, which may extend along the bole to near ground level.

This species is endemic to New South Wales where it occurs on subcoastal ranges and tablelands. It extends from the Orara River near Coffs Harbour south to the Budawang Range on the south coast. It is common in the sandstone gullies surrounding the Sydney region. Populations are discontinuous in the north of its range where some occurrences are restricted to high elevation, high rainfall sites. It has become naturalised in Victoria and in parts of south-western Western Australia.

In the southern part of its range cedar wattle grows along perennial creeks and rivers or is in proximity to run-on areas where supplementary groundwater can be obtained. The soils are deep, sandy and commonly derived from sandstone. Northern populations extend to volcanic substrates on high altitude, high rainfall sites. At these sites soils are well-developed clay loams.

Cedar wattle grows in tall open forests and on the margins of closed rainforests. There is a range of associated species including Sydney peppermint (*E. piperita*), brown barrel (*E. fastigata*), turpentine (*Syncarpia glomulifera*), rainforest species such as coachwood (*Ceratopetalum apetalum*), callicoma (*Callicoma serratifolia*) and lilly pilly (*Acmena smithii*).

Related species: The affinities of cedar wattle (sect. *Botrycephalae*) are uncertain. It is unlikely to be confused with any other bipinnate acacia due to its large dark green bipinnate leaves which are up to 23 cm long.

Publication: *London J. Bot.* 1: 383 (1842). Type: Shaded ravines, interior of New South Wales, A. Cunningham

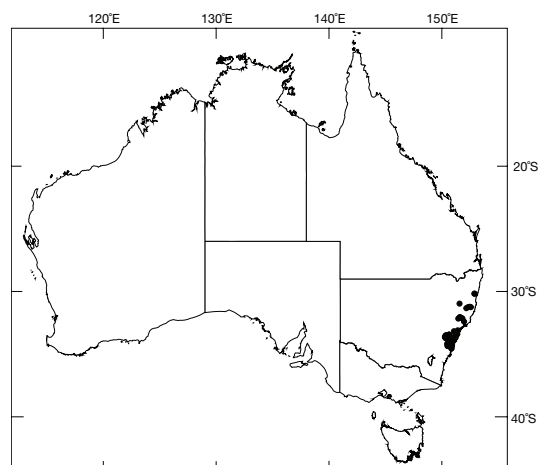
Names: Botanical—Latin *elatus* (exalted, tall), alluding to its stature. Common—presumably refers to the scent of the wood being similar to cedar (*Cedrela* spp. or *Cedrus* spp.).

Bark: Thin, finely fissured, grey-brown.

Foliage: Seedling—bipinnate. Adult—bipinnate, rachis up to 22 cm long, with usually 3–7 pairs of opposite pinnae, 7–23 cm long, pinnules in 8–22 pairs, 1–6 × 0.3–1.3 cm, lanceolate, acuminate, dark green above, lighter green below, petiole minutely hairy, to 9 cm long, with one gland midway along, jugary and interjugary glands absent.

Inflorescences: Axillary racemes or terminal panicles, up to 20 cm long, peduncles hairy, 2–11 mm long, heads 30 to 55-flowered, cream to pale yellow; flowers 5-merous, sepals fused. Flowers mainly late Dec.–Mar.

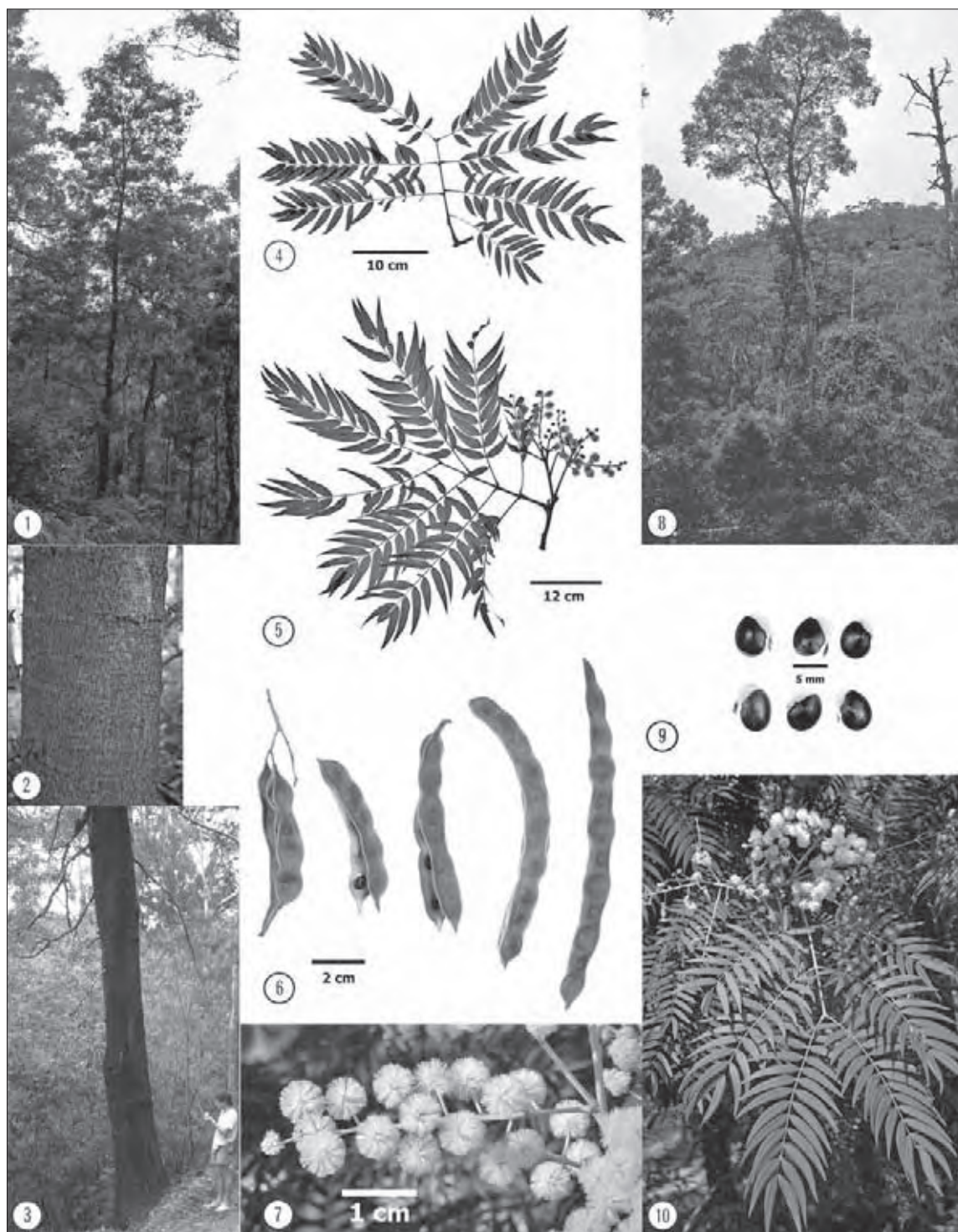
Fruits: Pods, narrowly oblong, slightly constricted between seeds, 4–17.5 × 0.9–1.5 cm, chartaceous to coriaceous, margin prominent, minutely hairy when young becoming sparsely hairy with age. Seeds longitudinally aligned, ellipsoid, glossy, black, aril white, cap-like. Mature Dec.–Feb.



Wood: Sapwood whitish, heartwood pale brown, density 670 kg m⁻³; scented, reminiscent of cedar. Reported to be excellent firewood and have potential for pulpwood production.

Climate: Altitudinal range: 50–1200 m; Hottest/coldest month: 23–29°C/–2–5°C; Frost incidence: moderate to high (up to 40 on upland sites with some snowfalls); Rainfall: 1000–1250 mm per year, moderate summer max.

Distinctive features: Medium-sized to large tree with large, dark green bipinnate foliage, up to 23 cm long; leaflets lanceolate, 2–6 × 0.5–1.3 cm; inflorescences in large axillary or terminal panicles, heads cream to pale yellow; pods oblong, 4–17.5 × 0.9–1.5 cm. The lateral branching of the crown is also distinctive.



Acacia elata 1. Tree, Glouster Tops, N.S.W. 2. Bark 3. Bole 4. Adult leaf 5. Inflorescence with adult leaf 6. Pods 7. Inflorescence 8. Tree, near Sydney, N.S.W. 9. Seeds 10. Adult leaf with inflorescence

Ironwood Southern Ironwood

Acacia estrophiolata F. Muell.

Ironwood is usually a graceful tree up to 15 m in height with a dbh up to 50 cm. The crown is spreading, often as wide as the tree is tall, and the pale green foliage is typically pendulous. Juvenile plants of this species differ in having broad, erect foliage and shrubby appearance which contrasts with the narrow, weeping foliage of mature trees.

Ironwood is a common, widespread species in central Australia. It extends throughout much of the southern half of Northern Territory and west to near Giles in Western Australia with a western outlier on Granite Peak Station, 300 km north-east of Meekatharra. It also extends into the far north of South Australia from the Mann Ranges east to the Lake Eyre region.

This species grows on plains, flood plains, creek banks and near drainage lines on low hills. Soils are reddish sandy loams or reddish, coarse alluvial sands derived from a wide range of rock types including schists and quartzites.

Ironwood grows in open shrublands and low open woodlands, commonly associated with mulga (*A. aneura*). A wide range of other species may be present which include eucalypts (*E. camaldulensis*, *E. aparrerinja*, *E. terminalis*, *E. coolabah*) and shrubs such as *Senna* spp. and *Hakea* spp.

Related species: Ironwood (sect. *Plurinerves*) is closely related to *A. excelsa*, which also has the common name ironwood and is a tall tree occurring in inland Queensland and inland northern New South Wales. The two species are very similar both having a weeping habit, however, *A. excelsa* differs in having shorter, broader phyllodes that lack the kink at the gland and it has wider pods.

Publication: *S. Sci. Rec.* 2, 150 (1882). Type: Finke River, Northern Territory, H. Kempe.

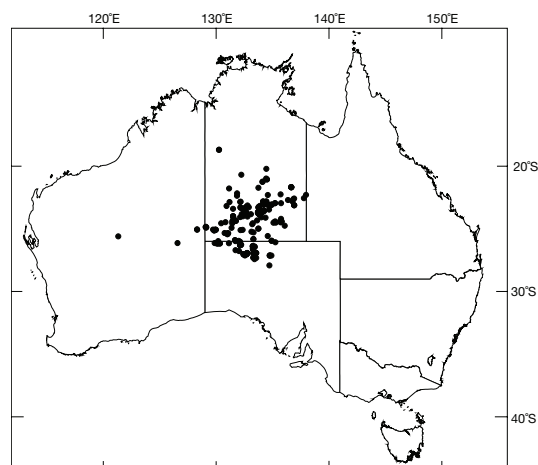
Names: Botanical—Latin *e* (without), *strophiola* (an aril), in reference to its seeds which lack an aril. Common—refers to the hardness of the wood.

Bark: Rough, longitudinally fissured, brown weathering to grey-brown.

Foliage: Seedling—first leaf pair pinnate with 5 leaflet pairs, second leaf bipinnate, at the third leaf stage the petiole elongates and flattens with a bipinnate leaf persisting at the apex, fourth or fifth leaf stage phyllodinous. Juvenile—phyllodes, erect, broad, crowded in clusters. Adult—phyllodes, pendulous, linear, often slightly kinked at the gland, 4–11 × 0.2–0.5 cm, coriaceous, pale green, nerves 3 or 4 sometimes with sparsely reticulate minor nerves; gland up to 1 cm from pulvinus.

Inflorescences: Simple, globular heads, 1–2 per axil on peduncles 0.5–1.2 cm long, heads 30 to 35-flowered, creamy to pale yellow; flowers 5-merous, sepals free. Apparently flowers irregularly in response to rain.

Fruits: Pods, oblong to narrowly oblong, 6–10 × 0.5–0.7 cm, chartaceous, transversely reticulate, breaking readily at constrictions between seeds, margins thickened. Seeds longitudinally aligned, oblong-elliptic, dull, brown, funicle

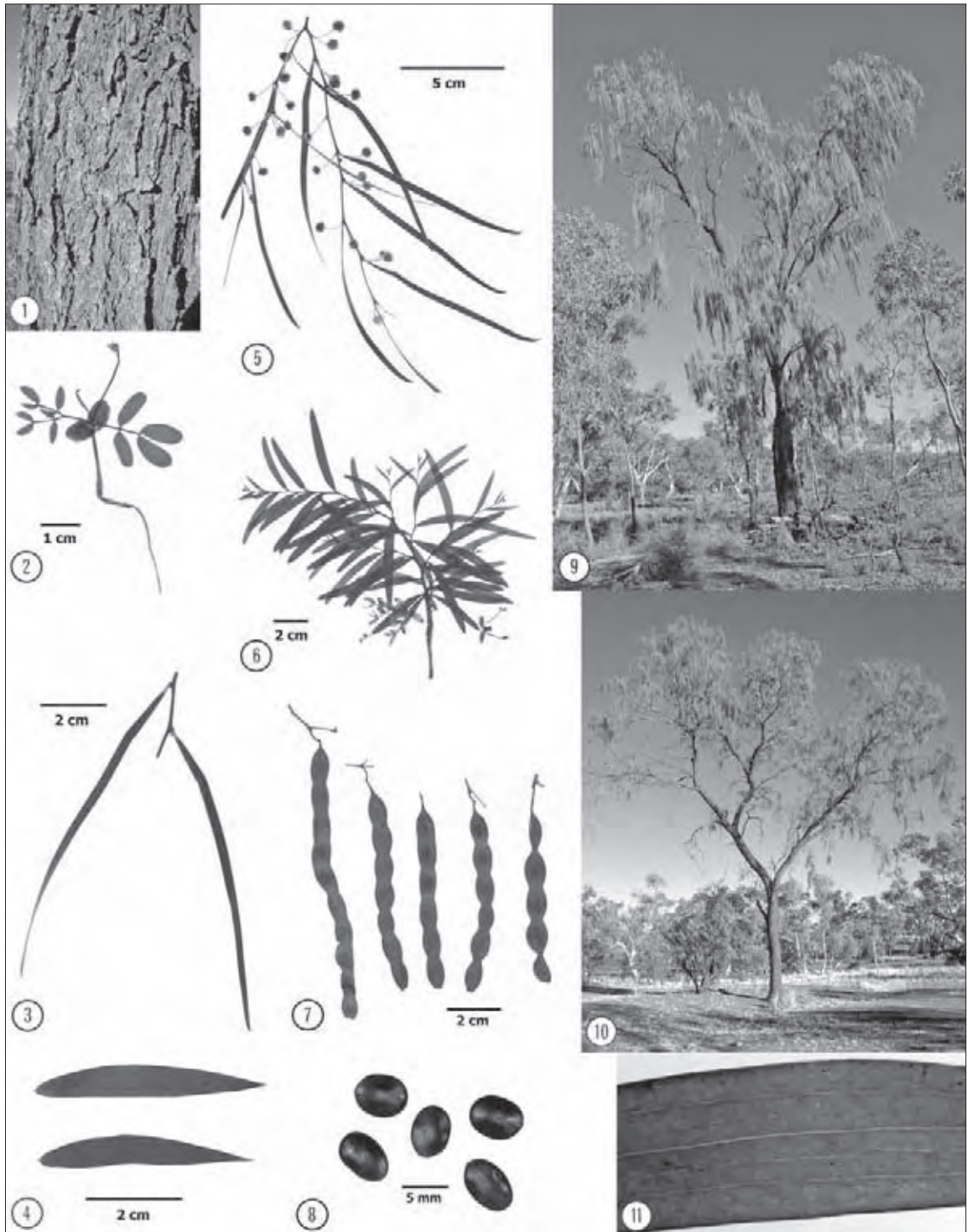


thin, aril absent. Mature pods are present during Nov.–Dec. and are held on the tree for considerable periods.

Wood: Heartwood dark brown, attractively grained, heavy, density probably around 1100 kg m⁻³; used for heavy implements by Aboriginal people but not a favoured firewood as it burns too slowly. A white gum exuded from holes made by borers is a food source for Aboriginal people.

Climate: Altitudinal range: 180–840 m; Hottest/coldest months: 36–39°C/4–8°C; Frost incidence: low to moderate; Rainfall: 150–300 mm per year, slight summer max.

Distinctive features: A graceful tree with a spreading pendulous crown; phyllodes with a slight kink at the position of the gland; flower heads, globular, axillary, 1–2 per axil, pale yellow; pods with thickened margins often unevenly constricted between the seeds; seeds with a thin funicle and lacking an aril.



Acacia estrophiolata 1. Bark 2. Young seedling 3. Adult phyllodes 4. Seedling phyllodes 5. Flowering sprig 6. Seedling 7. Pods 8. Seeds 9. Tree, Ongeva Creek, N.T. 10. Tree, Mueller Creek, N.T. 11. Phyllode nervation

Brigalow Brigalow Spearwood, Orkor

Acacia harpophylla F. Muell. ex Benth.

Brigalow is a small to medium-sized tree, usually 12–20 m tall. At its best it attains a height of 25 m and diameters of 0.6 m. It grows commonly in very dense stands in which the crown is restricted to the top one-quarter to one-third of the tree, the trunk being moderately straight. Sawlogs of 5 × 0.4 m are often available.

Brigalow is moderately to very common over an area of some 750 000 km² in eastern Australia. It has its greatest development over an area about 850 km long and up to 400 km wide from Collinsville in Queensland to the border with New South Wales, but it extends southwards a further 350 km to inland New South Wales. Although near the coast in some areas, its main distribution is 150–500 km from the sea in Queensland and up to 800 km in New South Wales.

Brigalow attains its best development on plains topography with heavy black clay soils and, while it extends to poor soils, it is rarely found on hills and ridges. Large areas of the best sites have been cleared for cropping, mainly wheat, but regrowth from root suckers, a strong characteristic of the species, is a limiting factor in the use of brigalow areas. In its main areas brigalow grows in very dense stands, often constituting 90 per cent of the vegetation. Associated species include Coowara box (*Eucalyptus cambageana*) and poplar box (*E. populnea*) as emergents. In some areas it may be co-dominant with belah (*Casuarina cristata*).

Related species: Brigalow (sect. *Plurinerves*) is related to black gidyea (*A. argyrodendron*) which also attains tree size but has smaller, 4-merous flower heads with fewer flowers per head (12 compared with 15–30 or more for brigalow), longer racemes, flat pods and occurs to the north of the brigalow belt mainly in the Cape, Suttor and Belyando River basins.

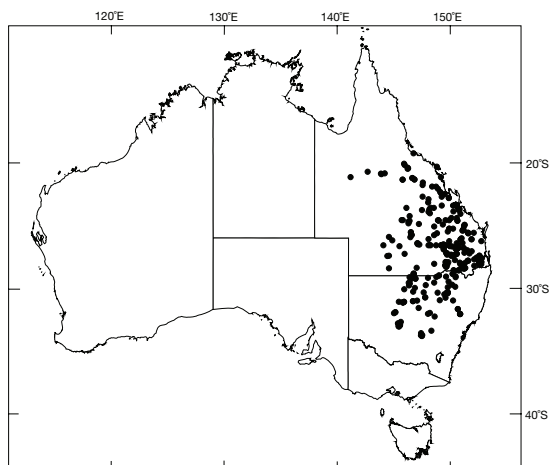
Publication: *Fl. Austral.* 2, 389 (1864). Type: Rockhampton area, Queensland, A. Thozet.

Names: Botanical—Greek *harpe* (sickle or hook), *phyllon* (leaf), in allusion to the shape of the phyllodes. Common—of Aboriginal origin.

Bark: Moderately thick (2–4 cm) on the lower stem, deeply furrowed longitudinally, hard, dark brown to almost black, persistent to the upper parts of stems; branchlets ribbed.

Foliage: Seedling—alternate, petiolate to 0.4–0.9 cm long, first two leaves pinnate with 4–7 pairs of leaflets which are shortly petiolate, oblong to obovate-oblong, straight or slightly falcate, obtuse, shortly mucronate, 0.4–1 × 0.1–0.3 cm, glabrous, green above and paler beneath; third leaf phyllodinous, 7–18 × 0.2–0.7 cm, bearing also 3 pairs of leaflets. Adult—phyllodes falcate, tapered equally to each end, mainly 10–20 × 0.7–1.6 cm, strongly pruinose, rather thick, usually glabrous; 3–5 rather prominent parallel longitudinal veins.

Inflorescences: Short 3–8 branched axillary racemes, which may sometimes be reduced to what appears to be few flower heads, heads 15 to 30-flowered, light yellow; 4 or sometimes 5-merous, sepals partially fused. Flowering is somewhat erratic but usually Jul.–Sept.

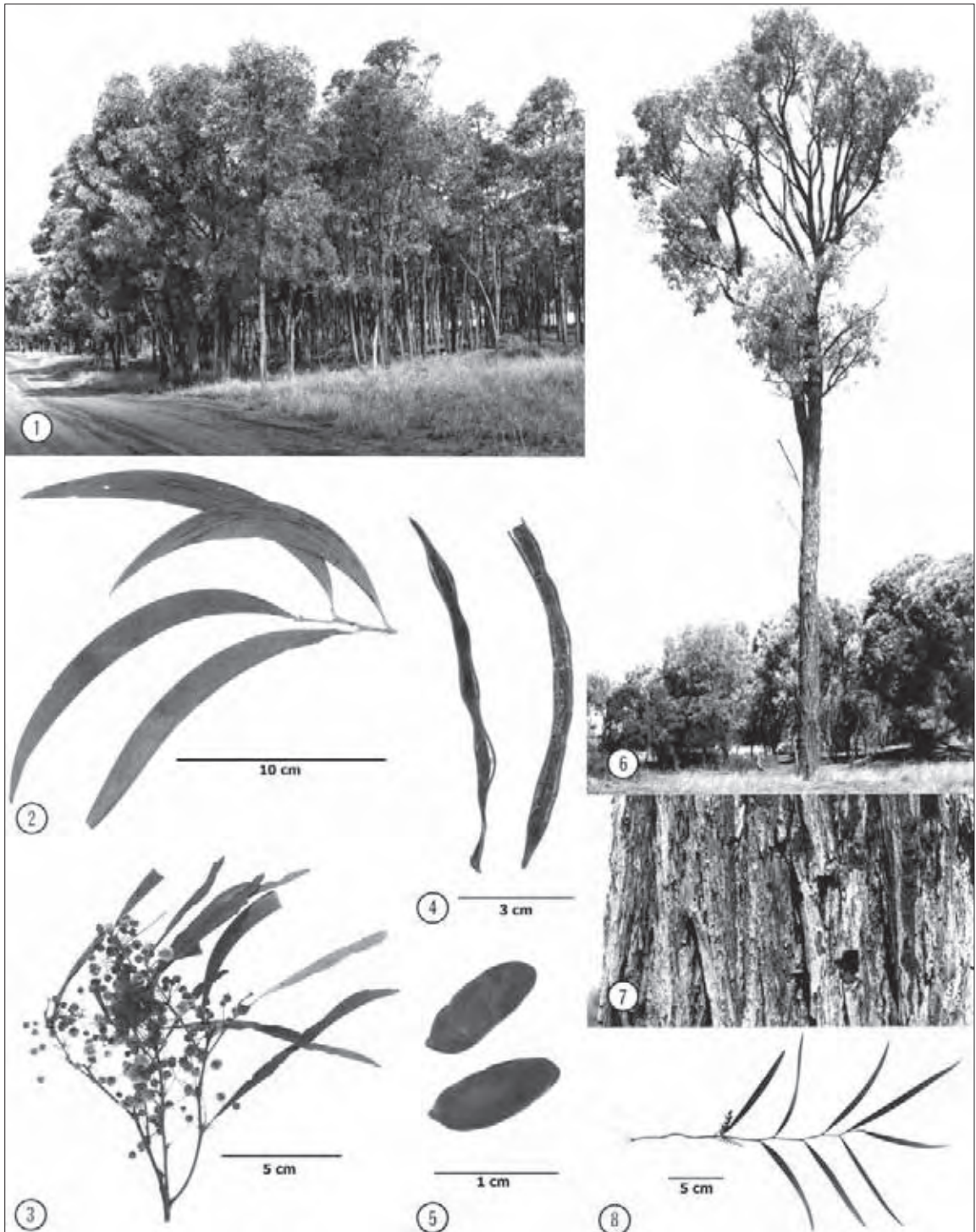


Fruits: Pods, narrowly oblong, subterete, slightly raised over and constricted between seeds, 7–20 × 0.5–1 cm, crustaceous, longitudinally nerved. Seeds longitudinally aligned, oblong or broadly elliptic, soft, dull, brown, funicle thin, aril absent. Mature Oct.–Nov.

Wood: Heartwood dark reddish brown, hard, very strong and at least moderately durable in the ground except sometimes for the sapwood, fine-textured, density 930–1135 kg m⁻³. It splits readily and takes a high polish, but is hard on tool edges; it has the faintest scent of violets. The heartwood is moderately resistant to fungi and very resistant to common Australian termites. Care is needed when handling green timber, as it may cause dermatitis. The timber is not usually marketed nowadays, but it has been used in the past for small, heavy construction as well as turnery and furniture. Formerly used by Aboriginal people to make weapons such as spear-shafts, boomerangs and nulla-nullas.

Climate: Altitudinal range: (50–)120–330 m; Hottest/coldest month: 32–34°C/4–7°C; Frost incidence: moderate (2–18 heavy frosts a year); Rainfall: 300–700 mm per year, summer max.

Distinctive features: This acacia is not readily confused with other species. In addition to the rather large, falcate, silvery-grey phyllodes, the apices of the leaves are obtuse and the pods longitudinally striate. This is a first-class tree for shelter, planted in single rows, as well as being a fine shade and ornamental species.



Acacia harpophylla 1. Stand of regeneration, near Moonie, Qld 2. Adult phyllodes 3. Inflorescences 4. Fruits 5. Seeds 6. Tree, near Emerald, Qld 7. Bark 8. Seedling

Wilyurwur

Acacia lasiocalyx C.R.P. Andrews

Wilyurwur is either a spindly shrub or small to medium-sized tree 10–15 m tall. Arborescent forms may be single-stemmed with a dbh to 50 cm, but more often the bole divides within a metre of ground level. The crown usually is many-branched and the branches steeply ascending, particularly on trees in dense stands. Trees in open stands have spreading crowns. Foliage is green, crowded towards the ends of the branches and notably curved. Saplings and shrub forms have smooth, pruinose, white bark on the upper stems.

This species is endemic to south-western Western Australia. It is wide ranging throughout the wheat belt extending from near Eneabba in the north of its range south to near Bremmer Bay and east to near Coolgardie and the Esperance region.

Wilyurwur grows in two habitats. It reaches its best development at the base of granite rock outcrops on sandy loams with relatively high organic content. It also grows as a spindly shrub on deep residual yellow sand plains.

This species grows in open woodlands or shrublands. At granite rock outcrops it is often associated with jam (*A. acuminata*), rock oak (*Allocasuarina huegeliana*) and sometimes coojong (*A. saligna*). Associated sand plain species are numerous including sugar brother (*A. coolgardiensis*), *Allocasuarina* spp. and a wide range of other shrub species.

Related species: Wilyurwur (sect. *Juliflorae*) belongs to the 'A. *doratoxylon* group', which also includes *A. anastema*, *A. conniana*, *A. longiphyllodinea* and *A. caroleae*. Of these it is closest to *A. conniana*, which occurs along the coast east of Esperance and mainly differs in having shorter, broader phyllodes and non-pruinose branchlets.

Publication: *J. Western Australia Nat. Hist. Soc.* 1, 41 (1904).
Type: Near Gairdner and Hamersley Rivers, Western Australia, Oct. 1903, C. Andrews.

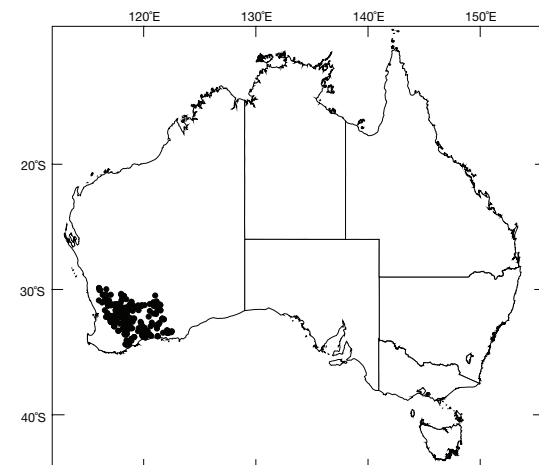
Names: Botanical—Greek *lasio* (hairy, woolly), *calyx* (cup or calyx of a flower), refers to the hairy calyx. Common—of Aboriginal origin.

Bark: Rough, longitudinally fissured, dark brown, smooth whitish grey above on tree forms. Saplings and shrub forms have smooth greyish bark that is pruinose and white on the upper stems.

Foliage: Seedling—first leaf pinnate with 3 leaflet pairs, second leaf bipinnate, soon phyllodinous. Adult—phyllodes, linear, normally curved and with a fairly abrupt curve at the apices, 13–30 × 0.2–1 cm, coriaceous, nerves, numerous, parallel, obscure except the midnerve.

Inflorescences: Simple, axillary, 2 to 10-headed rudimentary racemes (axes only up to 1 mm long), peduncles paired, 0.8–1.7 cm long, pruinose, spikes 2–4 cm long, densely arranged, golden; flowers 5-merous, sepals fused. Flowers Jul.–Oct.

Fruits: Pods, linear, raised over seeds, slightly moniliform, 8–16 × 0.4–0.6 cm, crustaceous. Seeds longitudinally aligned

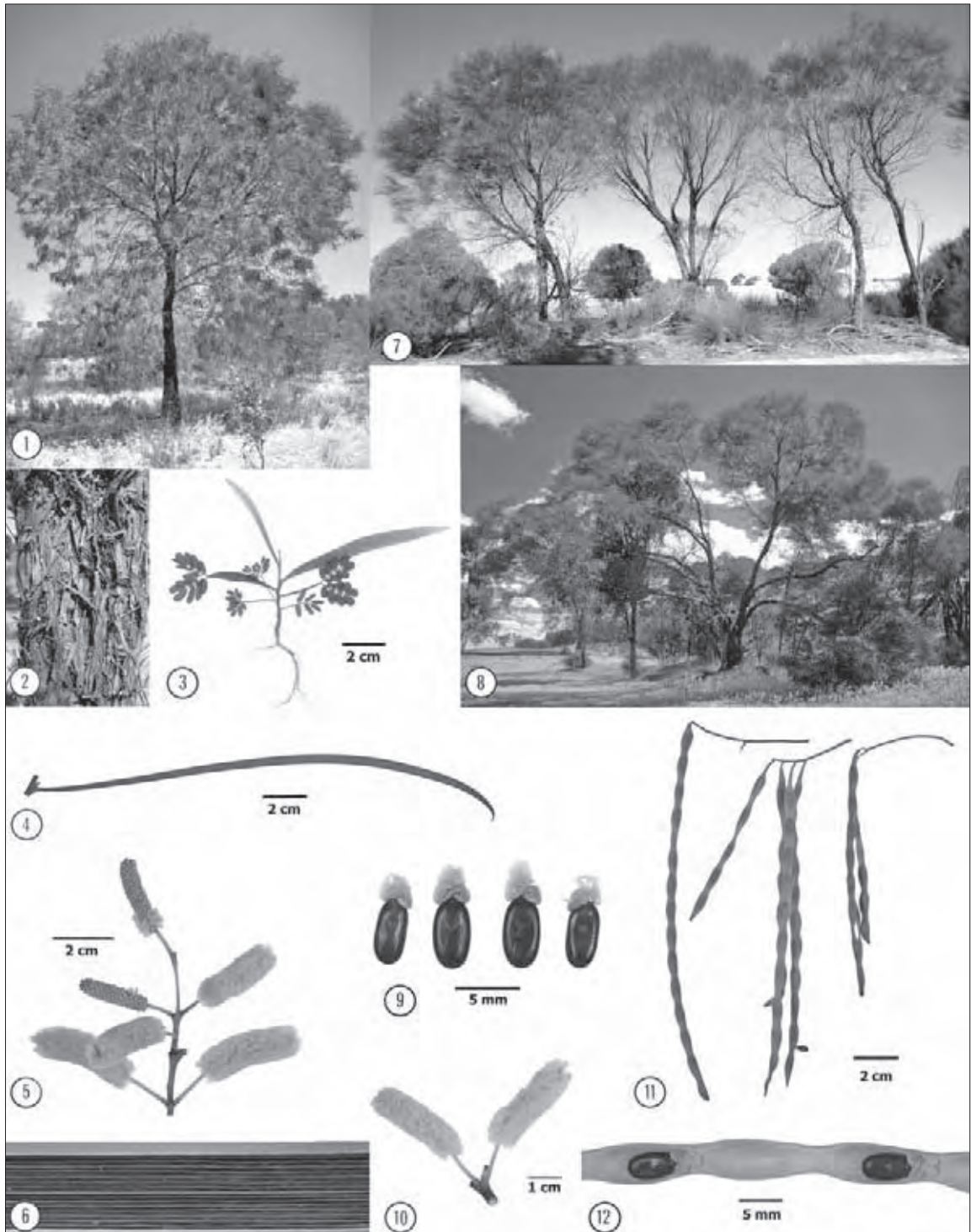


in pod, oblong to elliptic, glossy, dark brown, funicle-aril thick, thrice-folded. Mature Nov.–Jan.

Wood: Sapwood white, heartwood pale brown to yellow-brown, hard, density 795 kg m⁻³; the wood colour is atypical for a species in this group.

Climate: Altitudinal range: 100–400 m; Hottest/coldest month: 23–34°C/4–7°C; Frost incidence: low to moderate (1–6 per year at inland sites); Rainfall: 300–600 mm per year, winter max.

Distinctive features: Small to medium-sized tree occurring in proximity of granite rock outcrops or a spindly shrub occurring on yellow sand plains; saplings and shrub forms with smooth, pruinose, white upper bark; phyllodes long, narrow, abruptly curved towards the apices; flower spiked in pairs, densely arranged, golden; pods to 16 cm long, crustaceous, slightly moniliform.



Acacia lasiocalyx 1. Tree, Muntadgin Rock, W.A. 2. Bark 3. Seedling 4. Adult phyllode 5. Inflorescence 6. Phyllode nervation 7. Stand, near Karlgarin, W.A. 8. Tree, Kellerberin, W.A. 9. Seeds 10. Inflorescence 11. Pods 12. Seeds aligned in pod

Northern Silver Wattle

Acacia leuoclada Tindale

Northern silver wattle is a small or medium-sized tree commonly up to 10 m in height. The trunk often branches at about half tree height into a well-developed, dense crown that has a grey-green to silvery appearance. Maximum dbh development is in the range 30–50 cm. Clumps formed from root suckering are often evident in occurrences of this species. There are two subspecies, the typical and subsp. *argentifolia*.

Subsp. *leuoclada* occurs in New South Wales from the Warialda in the north to Wagga Wagga in the south and extends west to the Pilliga Scrub. Subsp. *argentifolia* occurs on the western slopes of the Great Dividing Range from the Kingaroy in south-eastern Queensland to the Koorlah region in northern New South Wales.

Northern silver wattle grows mainly on gravelly, sandy clay loams and sandy loams in hilly, undulating terrain or along creek banks. Many of its populations occur along degraded roadsides and in remnant vegetation on agricultural land, particularly in the south of its range. Soils are derived from a range of metasedimentary, granitic and volcanic substrates.

This species usually occurs in woodlands or sometimes in open forests, where it often forms pure stands. Associated species include yellow box (*E. melliodora*), cypress pine (*Callitris glaucophylla*), white box (*E. albens*) and Deane's wattle (*A. deanei*).

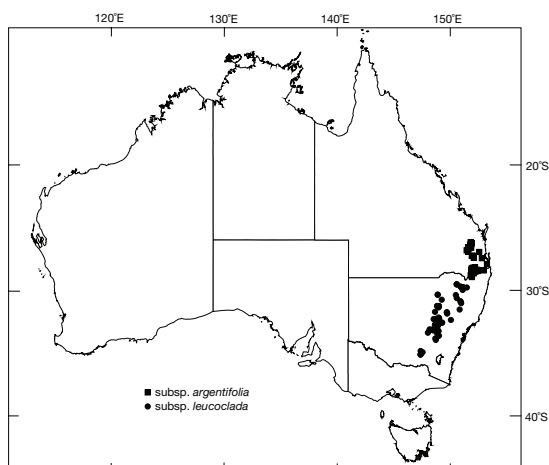
Related species: Northern silver wattle (sect. *Botrycephalae*) has close morphological affinities with silver wattle (*A. dealbata*). It differs from this species mainly by its leaf glands, which are smaller and more inconspicuous and by glands occurring between at least some pairs of pinnae. Differences between subsp. *leuoclada* and subsp. *argentifolia* are subtle and intermediates between the two occur. Subsp. *argentifolia* mainly differs in having branchlets that have undulate, shorter hairs and by its foliage that has fewer and less conspicuous glands.

Publication: *Proc. Linn. Soc. New South Wales* 91, 149 (1966). Types: Tunderbrine Creek, Warrumbungle Mountains, 3 Sep. 1953, A. Correy (*leuoclada*); 1 mile [1.6 km] N of Memerambi, 31 Oct. 1960, M. Tindale (*argentifolia*).

Names: Botanical—Greek *leucos* (white), *clados* (branch, shoot) refers to the white hairs on the branchlets and foliage, Latin *argenteus* (silver), *folium* (a leaf) refers to the silvery appearance of the leaves. Common—refers to the silvery foliage.

Bark: Lower bark, rough, furrowed, grey, brown or black; upper bark smooth, grey.

Foliage: Seedling—bipinnate, mainly with 3–5 pairs of pinnae and 10–15 pairs of leaflets; leaflets oblong on short petioles. Adult—bipinnate, up to 9.5 cm long, usually pruinose with 5–18 pairs of opposite pinnae, 1.5–5.5 cm long; pinnules in 11–45 pairs, 1–6 × 0.4–1 mm, strap-shaped to narrowly oblong, either glabrous above and hairy beneath or with minute, white, undulating hairs on both surfaces; glands at the base of one, most or all pairs of pinnae and with several glands along the rachis between pairs of pinnae; petiole terete, 0.5–3 cm long, with or without an apical or median gland.



Inflorescences: Axillary racemes or terminal racemes and panicles, peduncles usually hairy, 1–7 mm long, heads globular, 20 to 26-flowered, yellow or golden; flowers 5-merous, sepals fused. Flowers Jul.–Sept.

Fruits: Pods, narrowly oblong, straight or slightly moniliform, 3–12 × 0.5–1.2 cm, leathery, lightly pruinose, glabrous or with sparse, minute hairs. Seeds longitudinally aligned in pod, ellipsoid, dull, black; aril cream. Mature Nov.–Jan.

Wood: Sapwood white, heartwood pale brown; density 620 kg m⁻³. Reported to have excellent potential for pulpwood production.

Climate: Altitudinal range: 200–780 m; Hottest/coldest month: 26–32°C/0–3°C; Frost incidence: moderate to high; Rainfall: 530–850 mm per year, uniform (*leuoclada*) or summer max. (*argentifolia*).

Distinctive features: Medium-sized tree with silvery, bipinnate foliage occurring on the western slopes of the Great Dividing Range; leaves have small glands between at least some pairs of pinnae; often occurring in clumps with root suckering evident at the base of oldest trees.



Acacia leucoclada subsp. *leucoclada* (1), subsp. *argentifolia* (a) 1. Bark 2. Leaf rachis showing glands 3. Seeds 4. Flowering sprig 5. Tree, near Gilgai, N.S.W. (1) 6. Seedling leaf 7. Seedling 8. Tree, Maryland River, Qld (a) 9. Pods 10. Adult foliage

Mangium Brown Salwood, Hickory Wattle, Sally Wattle, Black Wattle

Acacia mangium Willd.

Mangium is a tree up to 20 m in height or sometimes 30 m. It typically has a dense crown of large, glossy green foliage. Its bole is usually straight, well developed and over half the tree height. Maximum dbh development is normally in the range of 50–60 cm, but the largest trees obtain up to 80 cm dbh. Minor buttressing develops at the base of the bole on old trees.

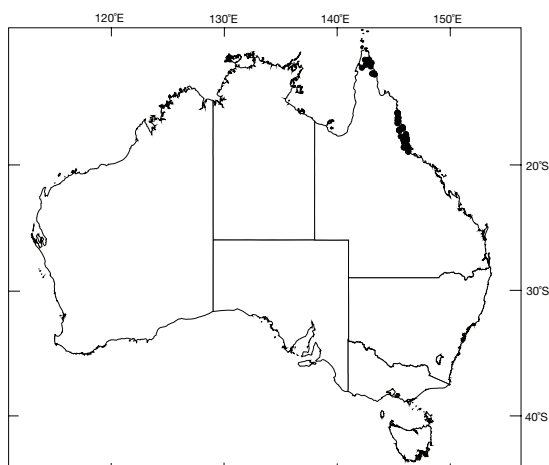
Mangium has a widespread but disjunct distribution. It has two main occurrences in northern Queensland. On Cape York it extends south from the Cockatoo Creek–Shelbourne Bay region to the Wenlock and Claudie Rivers. South of these stands there is a large break in its distribution until the Daintree area from where it extends south to the Townsville–Rollingstone area. It also occurs in southern lowlands of New Guinea and stands occur in parts of western West Papua (e.g. Sidei) and Maluku (e.g. Aru and Ceram Islands) in Indonesia.

Cape York occurrences are mainly on river flats. South of Daintree it occurs mainly on coastal plains with some extension into subcoastal low hills and ranges. Soils are acidic and range from sandy or loamy alluvium to red-brown loamy clay derived from granite, laterite, metamorphic or sandstone rocks.

This species typically occurs in open forests that fringe the margins of closed rainforests. Associated species include ear-pod wattle (*A. auriculiformis*), other salwoods (*A. celsa*, *A. crassicarpa*, *A. midgleyi*), pink bloodwood (*E. intermedia*), carbeen (*E. tessellaris*), cadaga (*E. torelliana*), large-fruited red mahogany (*E. pellita*), forest red gum (*E. tereticornis*) and swamp box (*Lophostemon suaveolens*).

Related species: Mangium (sect. *Juliflorae*) has closest morphological affinities with species in the ‘*A. holosericea* group’ (e.g. *A. colei*, *A. grandifolia*, *A. holosericea*, *A. nesophila*, *A. neurocarpa*, *A. pellita* and *A. tropica*). It is readily distinguished from these species by its arborescent habit, its large, glabrous, green, subglossy phyllodes that are sparsely reticulate, its white to cream-coloured inflorescences scattered along the rachis and by its seeds that have an orange aril. Natural hybrids involving mangium and ear-pod wattle (*A. auriculiformis*) are not uncommon where the two come into contact suggesting some affinity between the two species. Ear-pod wattle is readily distinguished by its narrower phyllodes, its broad, curved pods that form an open coil and by its flattened seeds that have an orange-red or yellow aril that encircles the seed.

Publication: Originally described in *Herb. Amboin.* 3, 123, t. 81 (1750) as *Mangium montanum* by Georgius Everhardus Rumphius (1627–1702), a German naturalist who studied natural history on the Indonesian island of Ambon. The combination *Acacia mangium* was made by C.L. Willdenow (1765–1812) in *Sp. Plant.* 4, 1053 (1806). Type: Willdenow based the type on the original description and figure published by Rumphius.



Names: Botanical—alludes to the phyllodes resembling leaves of ‘mangrove’ or mangroves in Indonesia. Common—the specific epithet is widely used.

Bark: Rough, shallowly furrowed, brown weathering to grey.

Foliage: Cotyledons—oblong or ovate, 4–5 mm long. Seedling—first leaf pinnate with 3 leaflet pairs, second to fourth leaves bipinnate, during subsequent stages the petiole elongates and flattens and the bipinnate leaf, comprising up to 9 leaflets pairs, persists at the apex, thereafter completely phyllodinous. Adult—phyllodes, obliquely elliptic to dimidiate, 9–27 × 3–10 cm, subglossy, green, glabrous, leathery, with 3 or 4 prominent longitudinal nerves confluent at base near lower margin, the minor nerves anastomosing to form an open, elongated reticulum; gland on upper phyllode margin up to 5 mm above the pulvinus.

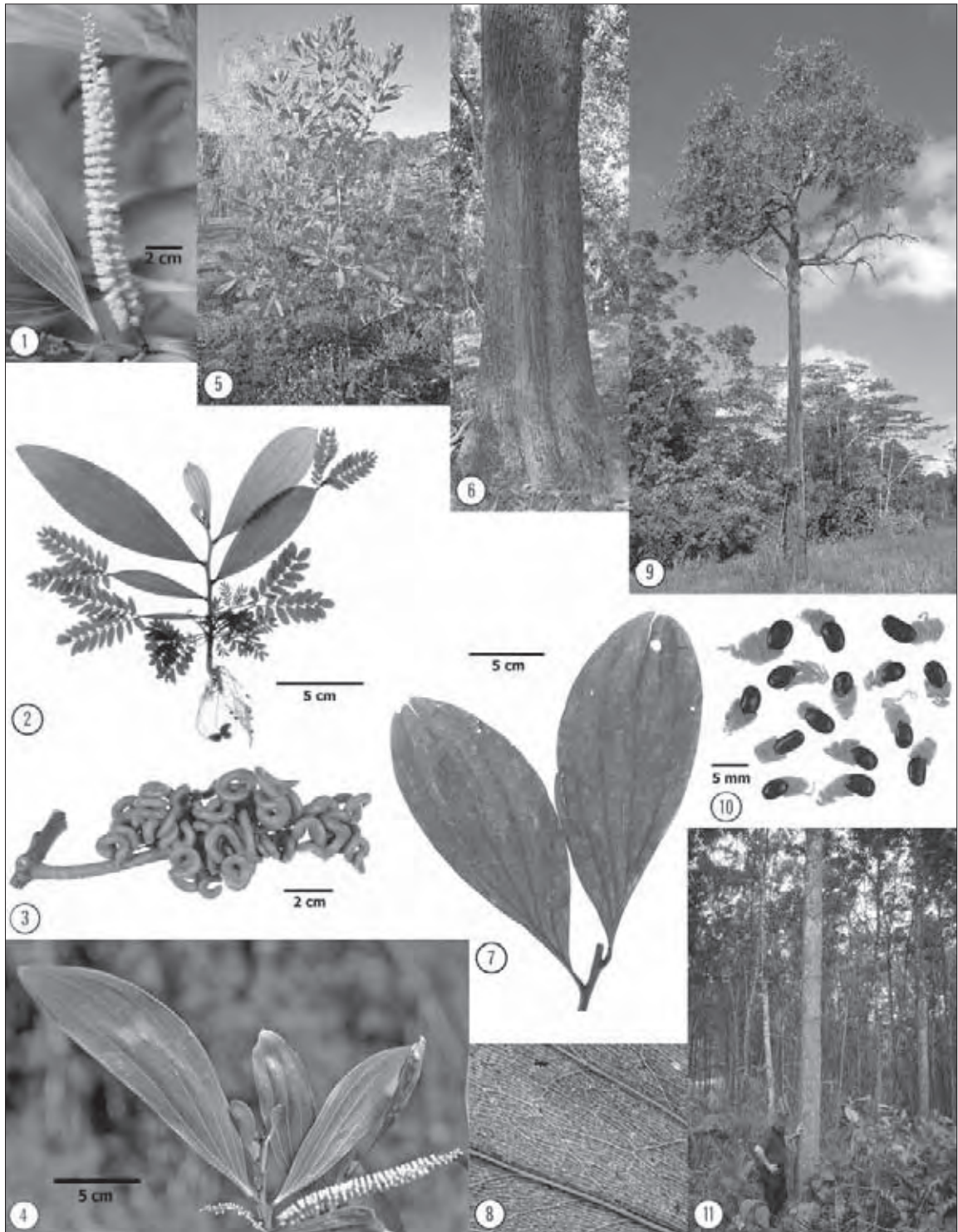
Inflorescences: Simple, axillary spikes, 1–2 per axil, up to 12 cm long, flowers subdensely arranged along rachis, white to cream; flowers 5–merous, sepals partially fused, hairy. Flowers May–Jun.

Fruits: Pods, linear, coiled, twisted or spirally coiled, leathery to almost woody, 3–5.5 mm wide. Seeds longitudinally aligned, oblong-elliptic, glossy, black, funicle-aril fleshy, yellow or orange. Mature Oct.–Nov.

Wood: Untreated sapwood susceptible to lyctid borer attack, sapwood narrow, pale yellow, heartwood pale yellow-brown, density 690 kg m⁻³, moderately hard. Used for a range of products including building and furniture timber, particleboard. Large plantations, mainly in Indonesia and Malaysia, are grown for woodchips to supply the paper pulp industry. Plantations for this purpose have also been established on the Tiwi Islands, Northern Territory.

Climate: Altitudinal range: near sea level to 750 m; Hottest/coldest months: 31–34°C/15–22°C; Frost incidence: low; Rainfall: 1200–3600 mm per year, summer max.

Distinctive features: A tree with a dense crown of large, shiny green foliage; phyllodes with 3–4 prominent longitudinal nerves and reticulate minor nerves; pods clustered, coiled, twisted or spirally coiled; seeds glossy, black with a yellow or orange aril.



Acacia mangium 1. Inflorescence 2. Seedling 3. Pods (maturing) 4. Adult phyllode and inflorescence 5. Cultivated sapling 6. Bole, Wenlock River, Qld 7. Adult phyllodes 8. Phyllode nervation 9. Tree, Mission Beach, Qld 10. Seeds 11. Plantation, Sarawak, Malaysia

Black Wattle

Acacia mearnsii De Wild.

Black wattle is a large shrub or small tree, commonly in the height range 6–10 m but at times attaining 15 m. It has a main stem which is usually straight and dominant for most of the tree height when growing in open forests.

This species occurs in south-eastern Australia, especially on coastal lowlands and the adjacent lower slopes of the tablelands and ranges, from near Sydney, New South Wales, to the south-eastern corner of South Australia, and at low and intermediate altitudes in Tasmania. It has become naturalised in parts of New South Wales, South Australia and Western Australia.

Black wattle occurs on gentle to moderately hilly topography and prefers easterly and southerly aspects. Good growth occurs on moderately deep forest loams derived from shales and slates.

Black wattle mainly grows in open forests but it extends to tall open forests, and there may be localised occurrences in woodlands or open woodlands. The dominant associated tree species are eucalypts, which vary from manna gum (*E. viminalis*) and mountain grey gum (*E. cypellocarpa*) in the moister valleys and on hill slopes to narrow-leaved peppermint (*E. radiata* subsp. *robertsonii*) at the higher elevations, with numerous stringybarks in coastal areas. Black wattle often tends to be the dominant shrub where it occurs, though other acacias and shrub genera may be present.

Related species: Black wattle (sect. *Botrycephalae*) has affinities with *A. parramattensis*, which has glabrous pinnules and branchlets.

Publication: *Pl. Bequaert* 3, 61 (1925). Type: from a cultivated plant near Thika, Kenya, wrongly believed by De Wildeman to have been indigenous.

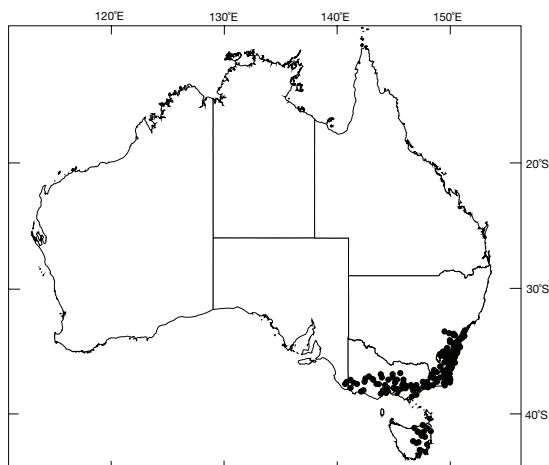
Names: Botanical—honours E.A. Mearns (1856–1916), the collector of the type specimen. Common—refers to the dark foliage and bark.

Bark: Somewhat variable on old trunks—usually brownish black, hard and fissured. On younger stems and the upper parts of older trees it is thinner, smoother and lighter in colour; tannin content high (see under Wood below).

Foliage: Seedling—sprawling, bipinnate, with 4–8 opposite pairs of pinnae, dark green; each pinna consists of 20–25 pairs of oblong leaflets. Adult—bipinnate with 8–21 pairs of pinnae and 15–70 pairs of leaflets; leaflets oblong, 1.5–4 × 0.5–0.75 mm, often minutely pubescent, olive green, concolorous; glands present between the pairs of pinnae on upper surface of leaf; overall length of compound leaf often 8–12 cm.

Inflorescences: Axillary or terminal panicles, about as long as the leaf, rachis hairy, heads globular, 20 to 38-flowered, pale creamy yellow; flowers 5-merous, sepals fused. Flowers Oct.–Dec.

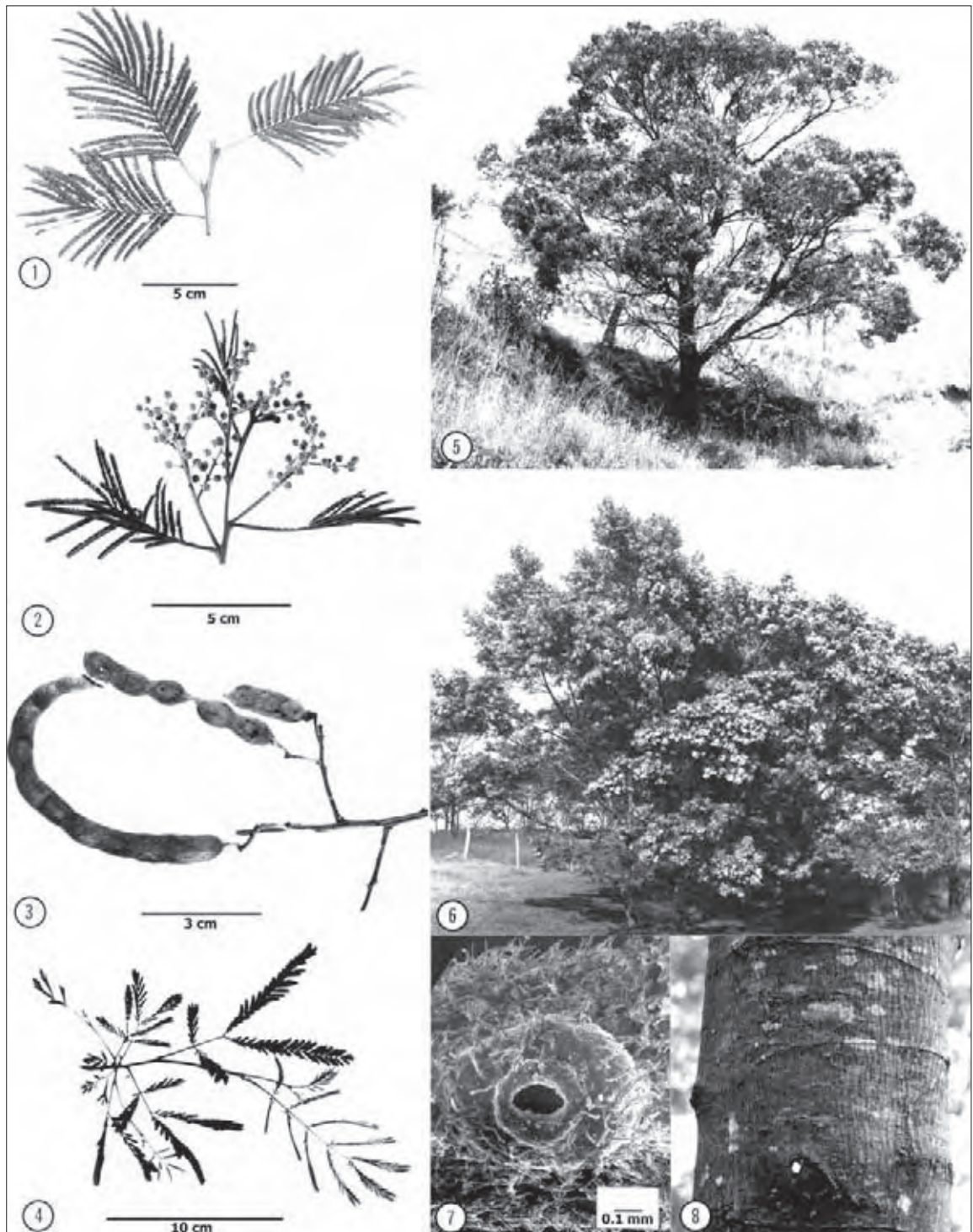
Fruits: Pods, narrowly oblong to broad linear, slightly moniliform, 5–15 × 0.4–0.8 cm, coriaceous, minutely hairy. Seeds longitudinally aligned in pod, ellipsoid, dull, black. Pods mature 14 months after fertilisation during Dec.–Jan (Mar.).



Wood: Sapwood very pale; heartwood light brown with reddish markings, very hard and tough, fine-textured but cross or interlocked grain common, low to moderate durability, density about 800 kg m⁻³. In the early days of settlement in New South Wales, Europeans recognised the useful fuel the tree provided, while the bark was later used for tanning (Searle 1997). It was soon grown overseas, initially for army fuel in India (1843) and then for amenity and fuel in Natal (1864). By 1884 the first bark for tanning was sold in South Africa. This led to extensive plantation establishment, with the wood also being used for light building construction. This acacia is probably the best example of an Australian tree which is used extensively overseas but almost ignored in its homeland. Formerly used by Aboriginal people to make weapons such as spear-shafts and boomerangs.

Climate: Altitudinal range: near sea level to 850 m; Hottest/coldest month: 21–29°C/–3–7°C; Frost incidence: low to high; Rainfall: 440–1600 mm per year, uniform to winter max.

Distinctive features: Dark green foliage; very small leaflets; narrow, more or less moniliform pods; glands between the pairs of pinnae on the upper surface of the hairy leaf rachis.



Acacia mearnsii 1. Adult leaves 2. Floral buds 3. Fruits 4. Seedling 5. Tree, north of Bega, N.S.W. 6. Stand, north of Bega, N.S.W. 7. Typical gland on leaf rhachis (S.E.M.) 8. Bark

Blackwood *Mudgerabah, Hickory, Sally Wattle*

Acacia melanoxylon R. Br.

Blackwood is often 10–20 m tall and up to 0.5 m in diameter, but varies from a small mountain shrub to one of the largest acacias in Australia, attaining heights of 35 m and diameters of 1–1.5 m on lowlands in north-western Tasmania and in the Beech–Cape Otway area of Victoria. In open situations the smaller and medium-sized blackwood trees are freely branched from near ground level, but the largest plants have a well-developed trunk.

Blackwood is widespread in eastern Australia, extending from the Atherton Tableland in northern Queensland, south through tablelands and coastal escarpments of south-eastern Queensland, New South Wales and Victoria to Tasmania. It extends west to the Mount Lofty Ranges in South Australia, with an outlier at Wirrabarra in the southern Flinders Ranges. Disjunctions occur throughout the range of the species, especially in Queensland and South Australia.

The topography varies from lowland swampy areas and the lower valley slopes of hilly and mountainous areas, to higher hill slopes and tablelands and even exposed mountaintops. Best growth is on good quality forest loams and alluvia but, as a smaller tree, the species grows on a wide range of soils including sandy loams and red clay loams.

The main vegetation types are cool temperate rainforests, tall open and open forests and open shrublands. In the south of its range it is associated with mountain ash (*Eucalyptus regnans*), with messmate (*E. obliqua*) and manna gum (*E. viminalis*). At the higher altitudes there may be myrtle beech (*Nothofagus cunninghamii*) and negrohead beech (*N. moorei*), with one of the larger tree ferns (*Dicksonia antarctica*) in cool, wet areas. In the drier and warmer areas there are many species of eucalypts and other acacias.

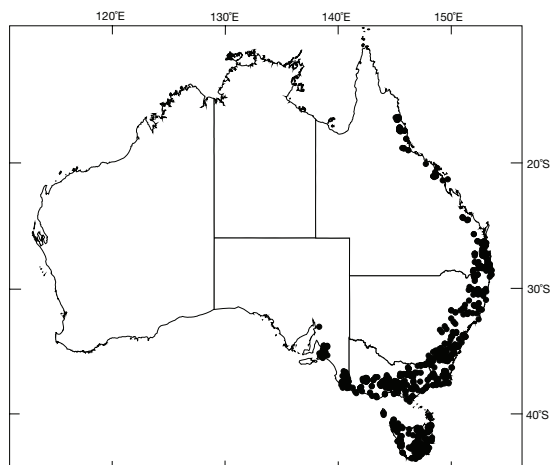
Related species: Blackwood (sect. *Plurinerves*) is related to *A. frigescens* (alpine areas of Victoria), *A. oraria* (north-eastern Queensland) and *A. cyclops* (south-western Western Australia). It is also related to the two extra-Australian species *A. koa* (Hawaiian Islands) and *A. heterophylla* (Mascarene Islands). Blackwood is often confused with lightwood (*A. implexa*), which mainly differs in having strongly falcate phyllodes, more sparsely anastomosing phyllode nervation and a cream aril.

Publication: *Hort. Kew.* 2nd edn 5, 462 (1813). Type: Port Dalrymple, Tasmania, Jan. 1804, R. Brown.

Names: Botanical—from the Greek words *melas* (black) and *xylon* (wood). Common—from the wood colour.

Bark: Varies in thickness from less than 0.5 to 5 cm at the base of very large trees. Hard, longitudinally furrowed but only slightly transversely, brownish grey to very dark grey. In moister environments the shady side of the stem often has a partial covering of light to mid-grey-coloured lichens.

Foliage: Seedling—bipinnate, mainly with 2–5 pairs of pinnae and 12–15 pairs of leaflets; leaflets almost sessile, oblong, about 0.8 × 0.2 cm, mid-green on the upper surface, slightly



paler on the undersurface; the mid-vein and lateral nervation of leaflets are visible with a 10-times magnifying hand lens; the phyllodes develop much later at about node 20. Adult—phyllodes narrow-ovate, somewhat falcate or dimitiate, 4–16 × 0.6–2.5 cm, more membranous than coriaceous; 3–5 prominent longitudinal nerves, minor nerves parallel and strongly anastomosing to form a fine reticulum.

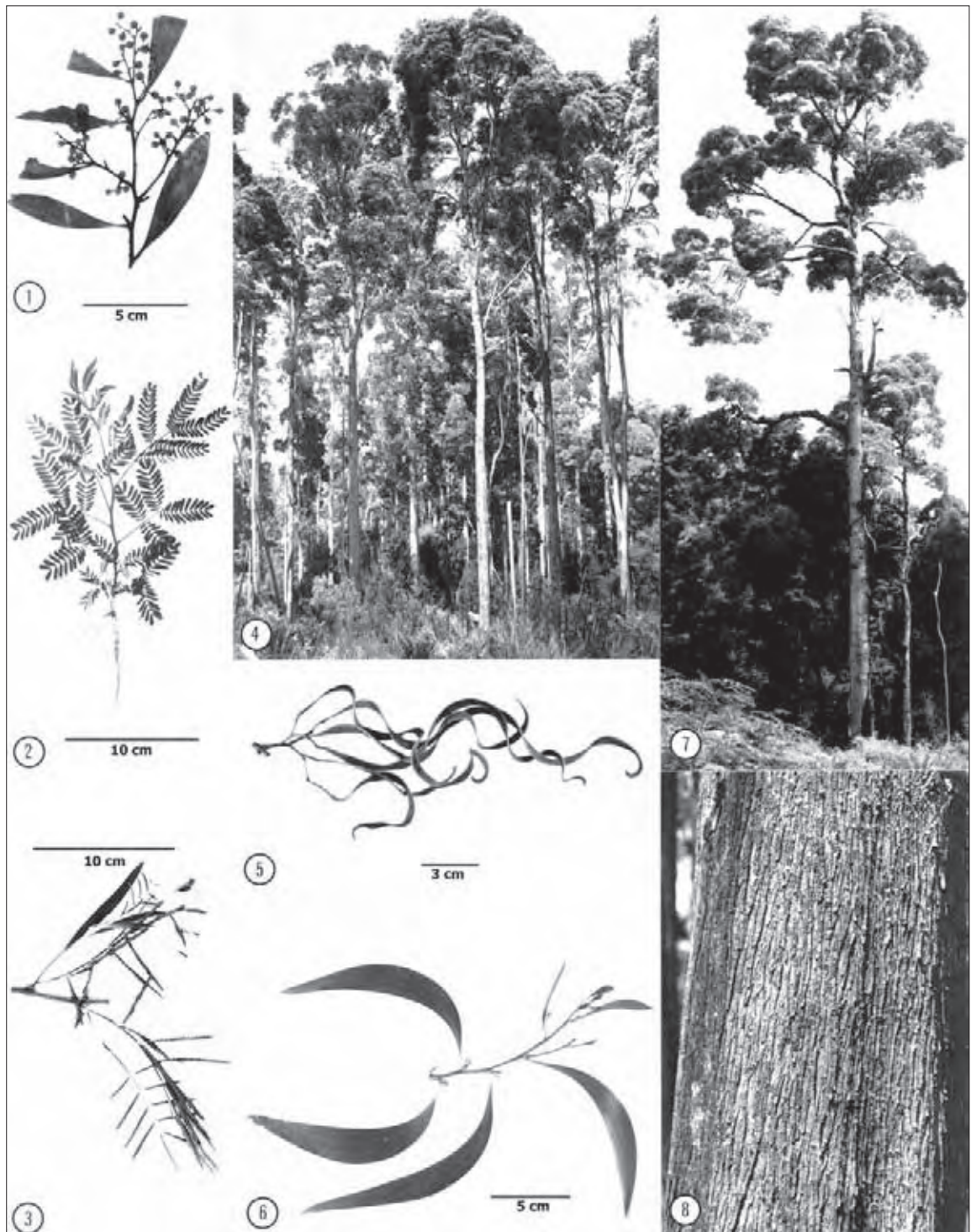
Inflorescences: Racemes, 3 to 5 headed, 0.6–4 cm long, peduncles 0.4–1.3 cm long, heads globular, 30 to 56-flowered, cream to very pale yellow; flowers 5-merous, sepals fused. Flowering starts in winter in the north and spring in the south.

Fruits: Pods, narrowly oblong, irregularly twisted or in up to 2 complete, tight coils, 6–10 × 0.4–1 cm, coriaceous. Seeds longitudinally aligned, ellipsoid, glossy, black, twice-encircled by a red, fleshy aril. Pods are smaller, more coiled and twisted in northern stands. Mature Oct.–Mar.

Wood: Sapwood white and up to 10 cm wide; heartwood golden-brown to darker brown, sometimes with reddish tint and dark streaks, growth rings distinct; not tough; grain usually straight but sometimes wavy or with beautiful fine-fiddleback, which with a high sheen makes blackwood one of the most decorative Australian timbers; density 475–790 kg m⁻³. One of the best hardwoods for bending. Availability of sound, large logs is limited and the timber is mainly used for sliced veneer, especially on particleboard, for cabinetwork and furniture. The wood takes a high polish. Recent uses include as ‘tonewood’ in guitars. Planted overseas in many countries.

Climate: Altitudinal range: near sea level to 1500; Hottest/coldest month: 23–30°C/1–10°C; Frost incidence: low to high (up to 40 frosts a year with a few light snowfalls each year at higher altitudes); Rainfall: 750–1500 mm per year, summer max. (northern stands) to winter max. (southern stands).

Distinctive features: Tree with phyllodes that have 3–5 prominent longitudinal nerves and minor nerves that form a net-like reticulum; cream, racemose flower heads; pods twisted or coiled often persisting on the tree well after maturation; seeds twice-encircled by a red aril.



Acacia melanoxylon 1. Floral buds 2. Seedling 3. Intermediate leaf stage 4. Stand, beside Arthur River, near Smithton, Tas. 5. Fruits 6. Adult phyllodes 7. Tree, Tas. 8. Bark

Myall Boree, Weeping Myall, Balaar, Silver-leaf Boree, Nilyar

Acacia pendula A. Cunn. ex Don.

Largest trees of myall attain heights of 12 m, but most are in the range 4–8 m tall. The trunk, which has a dbh up to 30 cm, usually divides into ascending branching at or up to 4 m from ground level. The canopy has a silvery appearance due to the presence of fine hairs on the phyllodes. Although crown branching is ascending, the terminal branchlets and foliage are strongly pendulous, sometimes extending to ground level.

The occurrence of myall is restricted to the plains and lower slopes of the mid to upper Murray–Darling drainage basin. It extends inland of the Great Dividing Range from the Emerald region in central Queensland, south through New South Wales to parts of the far north of Victoria, including an outlier in the Little Desert area.

This species grows on depositional landforms that include plains, seasonal drainage lines and the lower slopes of undulating terrain. Soils usually have heavy textured clay subsoil which are mainly grey, brown and black clays that may also be alkaline or saline.

Myall grows in low or open woodlands and grows in either pure stands or is associated with species such as poplar box (*E. populnea*), belah (*Casuarina cristata*), black box (*E. largiflorens*), coolibah (*E. coolabah*), gidgee (*A. cambagei*), cooba (*A. salicina*) and yarran (*A. omalophylla*).

Related species: Myall (sect. *Plurinerves*) is considered closest to yarran (*A. omalophylla*), which has a similar distribution to myall but differs in having darker bark, yellowish green, glabrous phyllodes and narrower, unwinged pods with longitudinally orientated seeds. Yarran is less pendulous than myall and has a strong propensity to form clonal clumps via root suckering.

Publication: *Gen. Hist.* 2, 404 (1832). Type: Lachlan River, New South Wales, Jun. 1817, A. Cunningham 434.

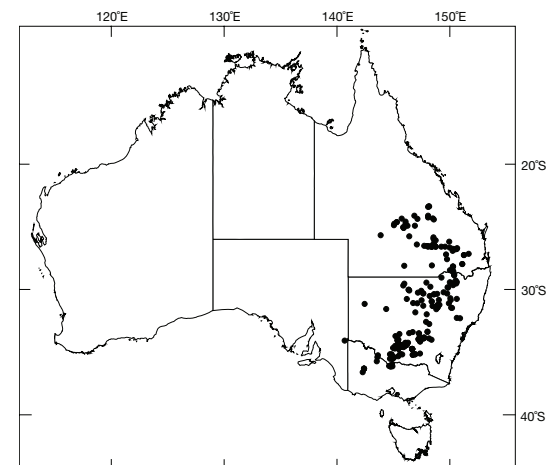
Names: Botanical—Latin *pendulus* (drooping), in reference to the drooping branchlets and foliage. Common—of Aboriginal origin.

Bark: Rough, longitudinally fissured, hard, dark brown.

Foliage: Seedling—first leaf pinnate with 3 leaflet pairs, next three stages bipinnate, thereafter the petiole elongates and expands and a bipinnate leaf persists at the apex for about 7 nodes until finally phyllodinous. Adult—phyllodes, narrowly elliptic, 5–14 × 0.4–1 cm, apex acute, coriaceous, densely hairy when young, glabrescent, longitudinal nerves numerous, closely parallel with 1–3 more prominent than the rest. Used as a fodder tree for stock during times of drought.

Inflorescences: Racemes, 2 to 7-headed, short, 0.2–0.9 cm long, minutely hairy; peduncles 3–8 mm long, heads globular, 12 to 25-flowered, light golden; flowers 5-merous, sepals free to partially fused. Flowering is unreliable but occurs mainly during May–Sept.

Fruits: Pods, narrowly oblong, thin, flat, 4–13 × 0.9–1.2 cm, more or less papery, with reticulate transverse nerves, minutely hairy; margins winged, wing 2–3 mm wide. Seeds transversely aligned in pod, broadly elliptic, 5–9 mm long,

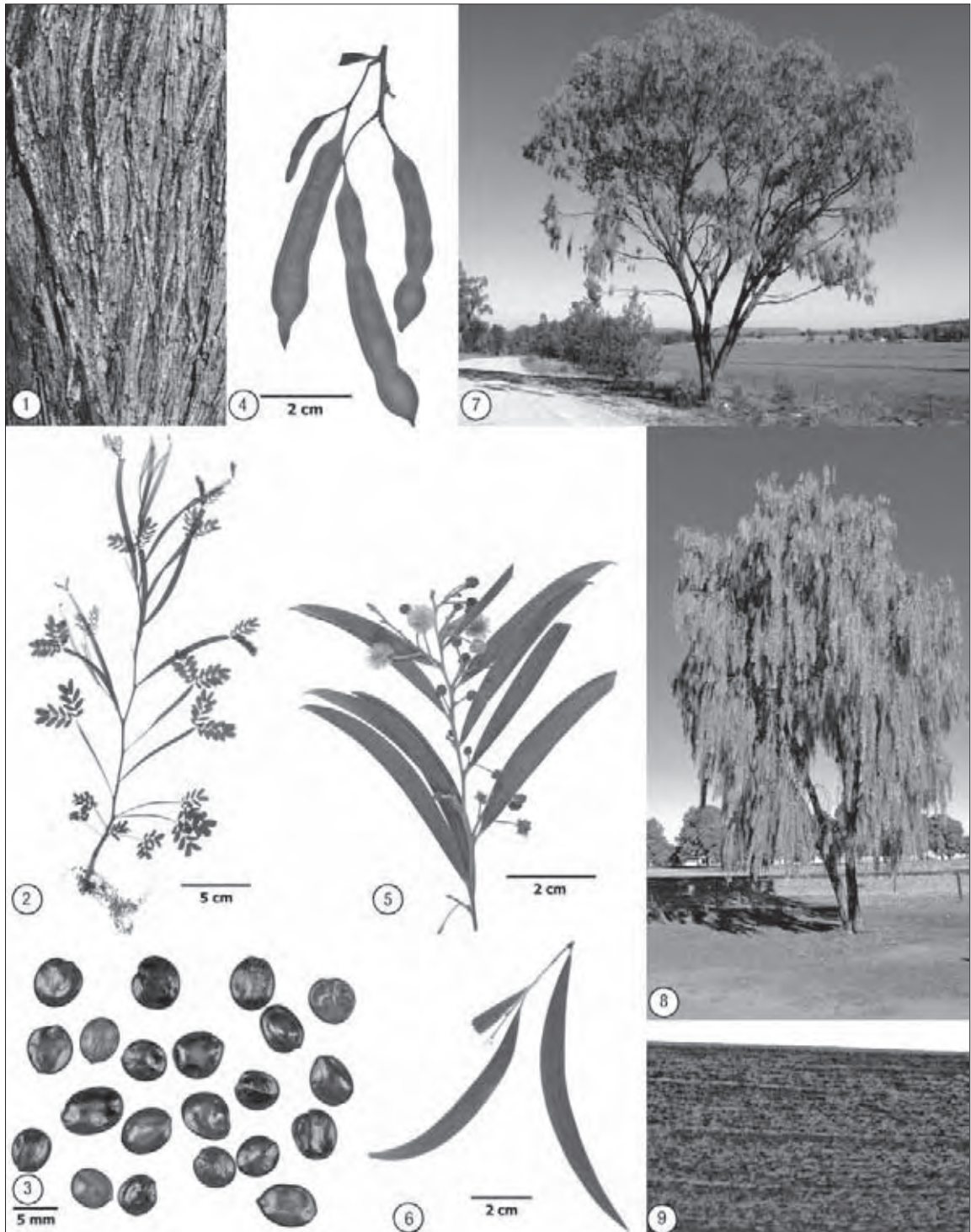


soft, funicle-aril not conspicuous. Mature Oct.–Dec., but not often produced.

Wood: Heartwood dark brown to purple-brown, hard, close-grained, density 1155 kg m⁻³, sweetly scented of violets; used for fence posts, firewood and turnery. Traditionally used by Aboriginal people to make boomerangs.

Climate: Altitudinal range: 90–35 m; Hottest/coldest month: 32–38°C/4–7°C; Frost incidence: moderate (1–20 frosts per year); Rainfall: 400–650 mm per year, uniform to summer max. in the north of its range

Distinctive features: Small tree with silvery, pendulous foliage, which often droops to ground level. This is a species commonly cultivated as an ornamental street tree in many parts of southern Australia.



Acacia pendula 1. Bark 2. Seedling 3. Seeds 4. Pods 5. Flowering sprig 6. Adult phyllodes 7. Tree, near Boggabri, N.S.W. 8. Cultivated tree, Crystal Brook, S.A. 9. Phyllode nervation

Waddy Waddywood, Casuarina, Birdsville Wattle

Acacia peuce F. Muell.

Waddy is a tree that may attain up to 15 m in height and have a dbh of up to 50 cm. The appearance of waddy is very reminiscent of a conifer or sheoak: young trees have short, lateral branching while mature trees have ascending branching but long pendulous foliage. Some stands of waddy are notable for their stately presence on otherwise treeless and shrubless plains. Juvenile plants are notable for their crowded, prickly foliage.

This species is limited to three disjunct occurrences. Two of these fringe the Simpson Desert: one at North Bore, Andado Station, Northern Territory and another to the north-west of Birdsville in western Queensland, while a third stand occurs on Montague Downs and Marion Downs in the Boulia area of western Queensland, 300 km north of Birdsville.

Waddy grows on broad, residual, stony alluvial plains. Soils are stony or gravelly, sandy loam over medium-textured clay, which may be saline or contain a high proportion of gypsum.

Waddy usually grows in pure stands in low open woodlands. Associated tree species are absent apart from some coolibah (*E. coolabah*) on drainage lines. Associated shrubs may include chenopods (e.g. *Atriplex*, *Rhagodia*), *Senna* spp., *Grevillea stricta*, *Atlaya hemiglauc*a and *Hakea leucoptera*, but otherwise grasses (*Astrebla* spp. and *Eragrostis* spp.) are the main associates.

Related species: Waddy (sect. *Phyllodineae*) is unlikely to be confused with other acacias due to its distinctive habit, its dimorphic juvenile and adult phyllode phases and its large pods with exarillate seeds. It has affinities to pink gidgee (*A. crombiei*), from central Queensland, which mainly differs in having flat, linear phyllodes, and to needle wattle (*A. carneorum*), from eastern South Australia and far western New South Wales, which has shorter phyllodes, narrowly oblong pods and seeds with a fleshy, yellowish aril.

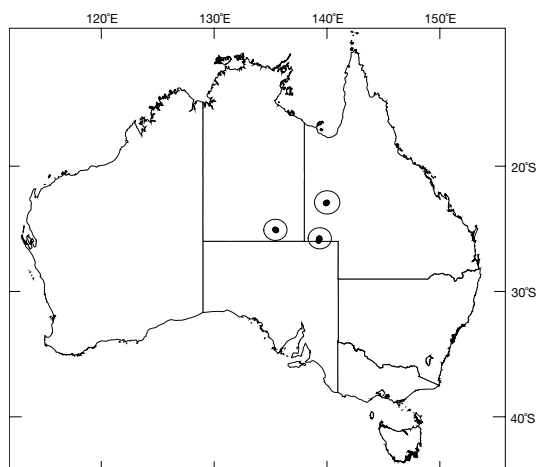
Publication: *Fragm.* 3, 151 (1863). Type: Wills Creek 25°30', A.F. Howitt and J.P. Murray.

Names: Botanical—Greek *peuce* (a pine tree), alluding to its appearance being reminiscent of a conifer. Common—an Aboriginal name for fighting stick.

Bark: Rough, fibrous, longitudinally fissured, brown weathering to grey-brown.

Foliage: Cotyledons—large, c. 1 × 0.5 cm, persistent. Seedling—first leaf pair pinnate with 5 leaflet pairs, thereafter phyllodinous, bipinnate phase absent. Juvenile—phyllodes, erect, somewhat rigid, quadrangular, 3–10 × 0.2–0.3 cm, crowded and densely arranged. Adult—phyllodes, pendulous, quadrangular in cross-section with a yellowish nerve at apex of each angle, 8–40 × 0.1–0.2 cm, pulvinus obscure, apices pungent; foliage palatable to stock.

Inflorescences: Simple, 1 per axil; peduncles 1.2–1.5 cm long, heads globular, pale yellow; flowers 5-merous, sepals fused near base. Flowers occur mainly during Oct. but may occur at other times in response to rain.

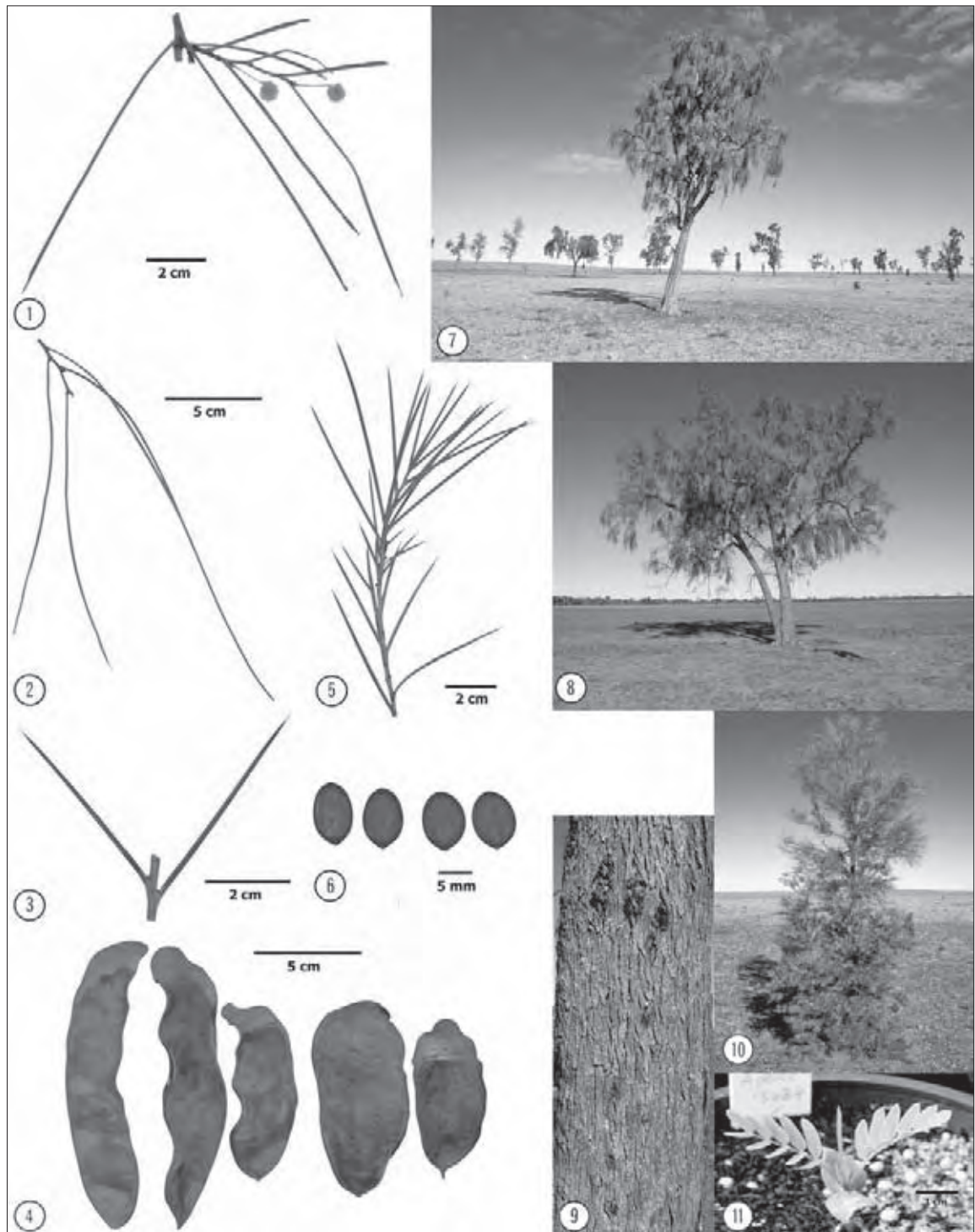


Fruits: Pods, oblong to narrowly oblong, 12–20 × 3–5 cm, chartaceous, transversely reticulate, pruinose. Seeds transversely aligned, elliptic to almost circular, flat, 6–14 × 4–8.5 mm, dull, dark brown-black, funicle thin, aril absent. Mature pods are produced sporadically but have been collected during Apr.–May and Sept.–Oct.

Wood: Heartwood dark brown to dark red, very close-grained, heavy, highly durable, termite resistant, extremely dense, density 1450 kg m⁻³; in the past used for fence posts and stock yard construction; Aboriginal people used it for making clubs.

Climate: Altitudinal range: 40–150 m; Hottest/coldest months: 39°C/6–8°C; Frost incidence: low; Rainfall: 150–260 mm per year, slight summer max.

Distinctive features: Tree with a conifer or sheoak (*Casuarina*) like appearance occurring in an arid, remote region often where few other tree species are present; phyllodes pendulous, quadrangular in cross-section with pungent tips; pods chartaceous, 3–5 cm wide; an important tree in Aboriginal mythology.



Acacia peuce 1. Flowering sprig 2. Adult phyllodes 3. Juvenile phyllodes 4. Pods 5. Juvenile sprig 6. Seeds 7. Stand, Andado, N.T. 8. Tree, Boulia, Qld 9. Bark 10. Sapling 11. Young seedling

Black Gidgee *Gidgee, Tawu*

Acacia pruinocarpa Tindale

Black gidgee is a multi-stemmed shrub 5–8 m tall or a tree up to 12 m in height. Boles may be somewhat fluted and up to 6 m in length with a dbh in the range of 25–50 cm. The canopy of larger specimens is usually spreading with large sinuous branches. The canopy is fairly dense and the relatively large blue-grey crown foliage is distinctive in the field.

This species occurs mainly in the mid-latitudes of Western Australia (Pilbara, Gascoyne, Murchison, far northern Goldfields) extending east into the Tanami Desert and Burt Plain regions of south-western Northern Territory. There are minor occurrences near the Tomkinson and Mann Range in north-western South Australia.

Black gidgee grows on a range of sites that include near watercourses, sandy or gravelly plains, the sand dune swales and the lower slopes and summits of plateaux. Soils are often gravelly sands or loams, which are often reddish due to high levels of iron oxide.

The most common vegetation structure of black gidgee is open shrublands. Occurrences are often in association with mulga (*A. aneura*) and a groundcover of spinifex (*Triodia* spp.); it is also associated with a wide range of other acacias (e.g. *A. ramulosa*, *A. ligulata*, *A. grasbyi*, *A. coriacea*, *A. sclerosperma*, *A. tetragonophylla* and *A. victoriae*) and arid zone species (e.g. *Grevillea striata*, *Rhagodia eremaea*). Associated species in open woodland occurrences near watercourses include river red gum (*E. camaldulensis*), coolibah (*E. coolabah*) and eucalypt bloodwoods such as tjuta (*E. terminalis*).

Related species: Black gidgee (sect. *Phyllodineae*) is related to *A. ensifolia*, which occurs in the Warrego District in southern central Queensland. It mainly differs in having gently attenuate phyllodes, which narrow to acute apices.

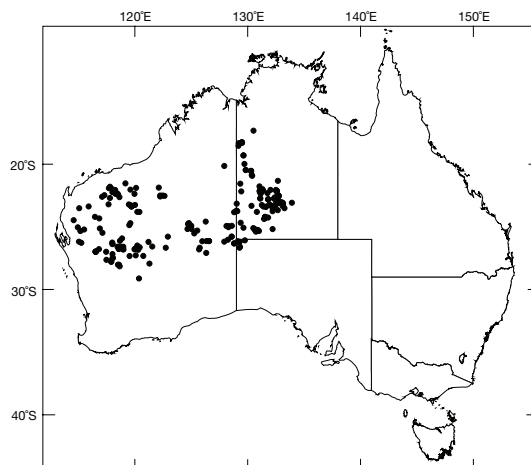
Publication: *Contr. New South Wales Natl Herb.* 4, 73 (1968).
Type: Pass of the Abencerrages, Rawlinson Ranges, Western Australia, 29 Jul. 1964, R. Hill 1353.

Names: Botanical—Latin *pruinus* (frosty), Greek *carpos* (fruit) alluding to the pruinose pods. Common—gidgee is of Aboriginal origin and commonly used for *A. cambagei*.

Bark: Rough, longitudinally fissured, dark brown weathering to grey-brown. Aboriginal people eat the sweet sap exuded from the trunk.

Foliage: Seedling—first leaf pinnate, mostly with 5 leaflet pairs, second leaf bipinnate, at the third leaf stage the petiole elongates and flattens with a bipinnate leaf persisting at the apex, following leaf stages finally phyllodinous. Adult—phyllodes, usually spreading widely, linear to linear-elliptic, 7–17 × 0.6–3.0 cm, apices obtuse to subacute, thick, coriaceous, blue-green; midnerve prominent; glands 2–5. The foliage is readily eaten by stock when other feed is scarce; phyllode crude protein content is reported to be relatively high.

Inflorescences: Racemes, 6 to 20-headed, 3–15 cm long, stout, often pruinose, peduncles 1–4 cm long, mostly in 2s or



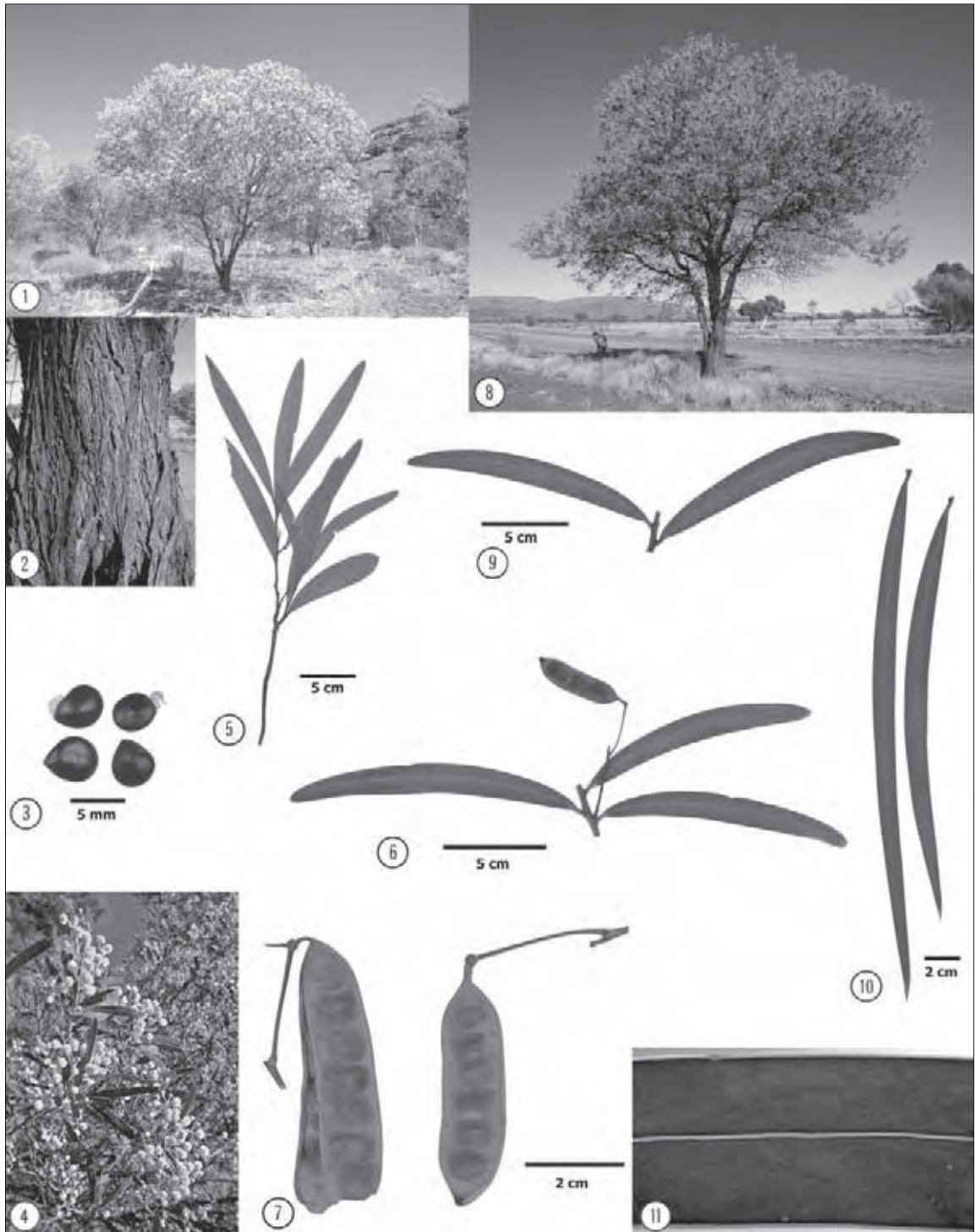
3s, heads globular, 55 to 110-flowered, light golden; flowers 5-merous, sepals fused. Flowers Oct.–Dec.

Fruits: Pods, narrowly oblong, to 12 × 0.9–1.7 cm, more or less chartaceous, usually pruinose, convex over the seeds. Seeds transverse to obliquely aligned in pod, ovate to oblong-elliptic or suborbicular, glossy, black, aril cap-shaped, cream. Mature Jan.–Feb.

Wood: Sapwood whitish, heartwood dark brown, close-grained, heavy, considered highly durable, density 1150 kg m⁻³; availability limited but considered to have good potential for craftwork and ornamental wood products.

Climate: Altitudinal range: 450–750 m; Hottest/coldest months: 36–38°C/3–7°C; Frost incidence: low; Rainfall: 200–275 mm per year, summer max.

Distinctive features: Tree or large shrub with a spreading crown of blue-grey foliage; phyllodes uninerved, with 1–5 glands; pods usually pruinose.



Acacia pruinocarpa 1. Tree, Wittenoom Gorge, W.A. 2. Bark 3. Seeds 4. Inflorescences 5. Seedling 6. Adults phyllodes with pod 7. Pods 8. Tree, near Docker River, W.A. 9. Adult phyllodes 10. Juvenile phyllodes 11. Phyllode nervation

Golden Wattle Broad-leaved Wattle

Acacia pycnantha Benth.

Golden wattle is a shrub or small tree up to 5 m in height but sometimes attains a height of up to 8 m with a dbh to 25 cm. The trunk often divides into several main stems close to, or at, ground level. The upper main stems have smooth sometimes white, pruinose bark. The crown has green somewhat glossy foliage and is crowded at the end of the branches on mature plants. This species was proclaimed as Australia's official National Floral Emblem in 1988.

Golden wattle occurs naturally in Victoria, south-eastern South Australia, southern inland New South Wales and the Australian Capital Territory. It is widespread in Victoria extending throughout inland parts of the State. It has some extension north into New South Wales, where it occurs along the southern slopes of the Great Dividing Range, with outlying occurrences near Broken Hill and on hills in the Australian Capital Territory. In South Australia it extends as far west as the Eyre Peninsula, north to the Flinders Ranges and south to Kangaroo Island. It has become naturalised in many parts of southern Australia, including south-western Western Australia.

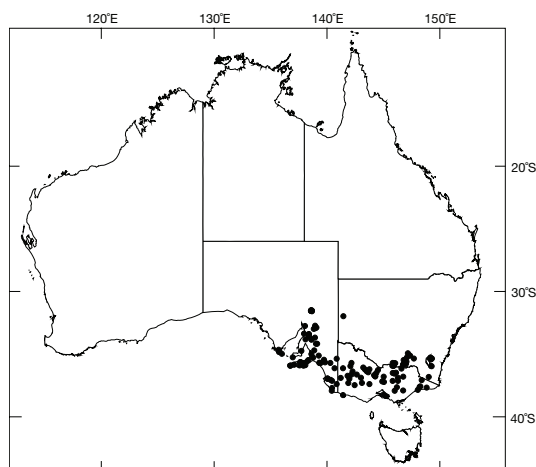
Golden wattle grows on a range of sites and does not appear to be particularly habitat-specific. Sites range from rocky ridge tops to low undulating terrain and plains. Soils include a wide variety such as calcareous sands, clays and shallow, stony loams. Rock substrates also include a wide variety including shale, sandstone, quartzite, granite, sand dunes and alluvium.

Golden wattle grows in a wide range of vegetation structural types from open shrublands to open forests. It is associated with numerous species throughout its range including a diverse range of eucalypts such as sugar gum (*E. cladocalyx*), messmate (*E. obliqua*), red gums (*E. camaldulensis*, *E. blakelyi*), red stringybark (*E. macrorhyncha*), broad-leaved peppermint (*E. dives*), yellow box (*E. melliodora*), manna gum (*E. viminalis*), white box (*E. albens*), soap mallee (*E. diversifolia*), green mallee (*E. viridis*) and mallee box (*E. porosa*).

Related species: Golden wattle (sect. *Phyllodineae*) is closely related to *A. pedina*, which occurs on the South Coast of New South Wales and differs in having 25 to 40-flowered heads, oblanceolate to obovate adult phyllodes and large juvenile and intermediate phyllodes. Golden wattle may be confused with a number of other species that have phyllodes with prominent midnerves and golden flower heads borne in racemes. These species include *A. leiophylla*, Gill's wattle (*A. gillii*), coojong (*A. saligna*) and mountain hickory wattle (*A. obliquinervia*).

Publication: *London J. Bot.* 1, 351 (1842). Type: Interior of New Holland (between the Loddon River and Pyramid Hill, Victoria), 5 Jul. 1836, T.L. Mitchell 222.

Names: Botanical—Greekl *pycnos* (close, crowded), *anthos* (flower) in reference to the crowded flowers. Common—in reference to its flower colour.



Bark: Rough, dark brown and shallowly fissured at base, smooth, thin above, brown or sometimes pruinose (white or whitish grey); tannin content very high.

Foliage: Seedling—first two leaves pinnate with 3–4 pairs of leaflets, third leaf bipinnate, thereafter the petiole elongates and flattens with a bipinnate leaf persisting at the apex until finally phyllodinous. Adult—phyllodes, pendulous, falcate to oblanceolate, much tapered at base, 9–15 × 10–3.5 cm, coriaceous, penninerved with midvein prominent; glands 1–2, lowermost to 4.5 cm above pulvinus.

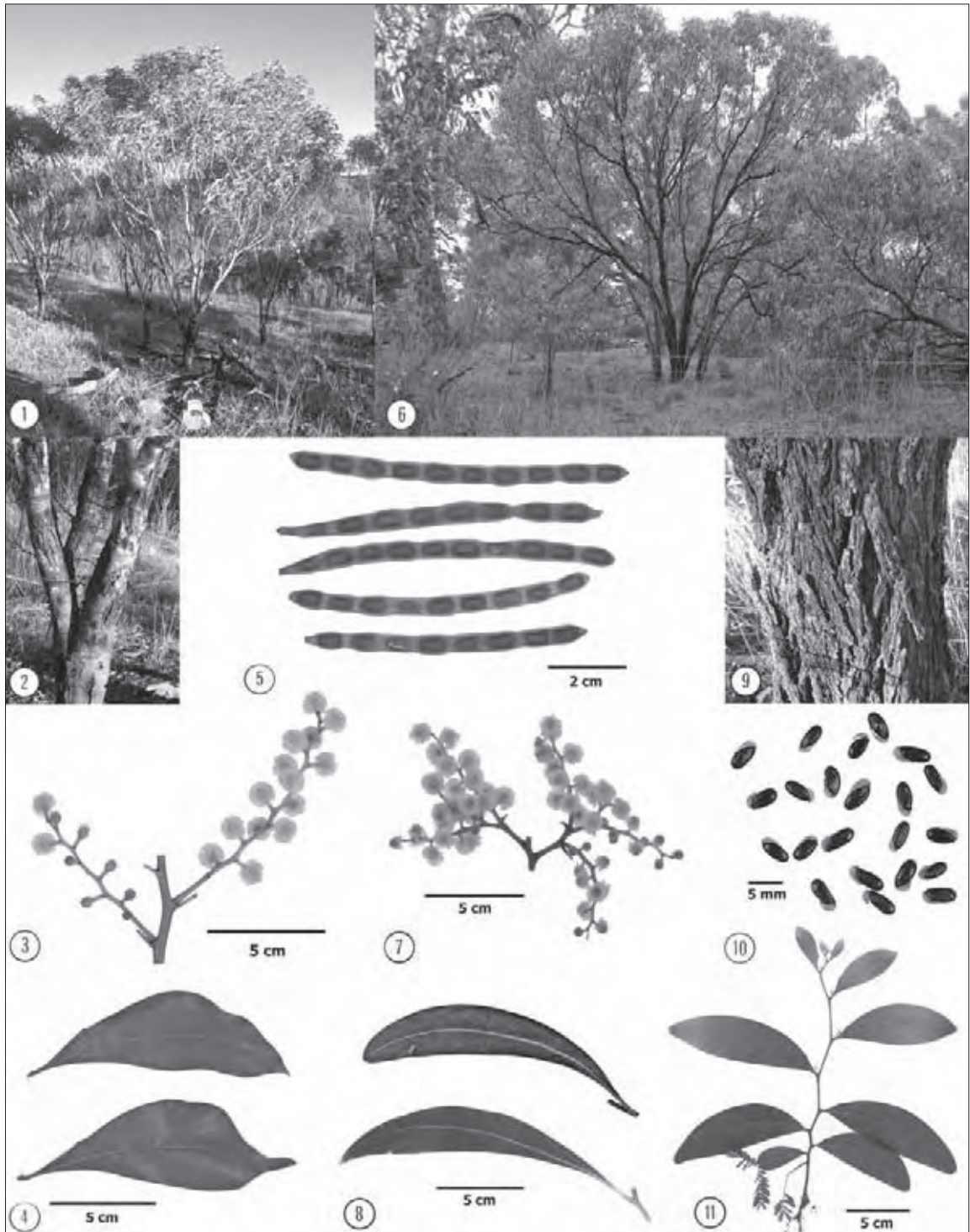
Inflorescences: Axillary racemes, 2.5–9 cm long, stout, peduncles 0.3–0.6 cm long, heads globular, 40 to 80-flowered, bright golden; flowers 5-merous, sepals fused. Flowers Jul.–Nov.

Fruits: Pods, linear, 5–13 × 0.5–0.7 cm, chartaceous to thinly coriaceous. Seeds longitudinally aligned in pod, oblong, slightly glossy, black. Mature Nov.–Jan.

Wood: Heartwood pale brown, hard, density about 700 kg m⁻³; makes good firewood.

Climate: Altitudinal range: near sea level to 325 m with isolated occurrence higher; Hottest/coldest month: 23–36°C/4–9°C; Frost incidence: low to moderate (1–6 per year inland); Rainfall: 300–1000 mm per year, winter max.

Distinctive features: Shrub or small tree with with glossy foliage; phyllodes with one central nerve, much tapered at base; inflorescences in racemes with large, 40 to 80-flowered, golden flower heads.



Acacia pycnantha 1. Shrub, Mt Remarkable, S.A. 2, 9. Bark 3, 7. Inflorescence 4. Juvenile phyllodes 5. Pods 6. Tree, Anguston, S.A. 8. Adult phyllodes 10. Seeds 11. Seedling

Cooba Motherumba, Broughton Willow, Native Wattle (S.A.), Doolan (Qld.), Willow Wattle (N.S.W.), Sally Wattle (Qld.)

Acacia salicina Lindl.

Cooba is a tall shrub or tree usually 5–12 m tall although it may grow to 18 m in height at some sites. The dbh is usually less than 50 cm, but old specimens may greatly exceed this, and the bole may be up to half the tree height (often shorter). The crown has relatively long pendulous foliage often drooping to near ground level. Sapling regrowth derived from root suckering often surrounds large trees.

This is a widespread species in eastern Australia colonising most of the Murray–Darling and Lake Eyre drainage basins. Its main occurrence is in central, southern Queensland and western New South Wales but also extends over much of eastern South Australia. In the Northern Territory it occurs in the Alice Springs–Finke region and is restricted to the dry north-western corner of Victoria.

Cooba grows mainly along the banks of rivers and creeks, particularly in arid and semi-arid areas. It also grows on gentle slopes, alluvial plains and floodplains. Soils are usually moderate to heavy textured alluvial clays. They are sometimes overlain with sand and also include coastal and inland sand dunes and soils of limestone, sandstone and volcanic origin.

Vegetation structure ranges from open forests, to woodlands and open shrublands. Cooba often forms pure small clumps and is associated with other riparian species, which most commonly include river red gum (*E. camaldulensis*), coolibah (*E. coolabah*), black box (*E. largiflorens*) and river cooba (*A. stenophylla*).

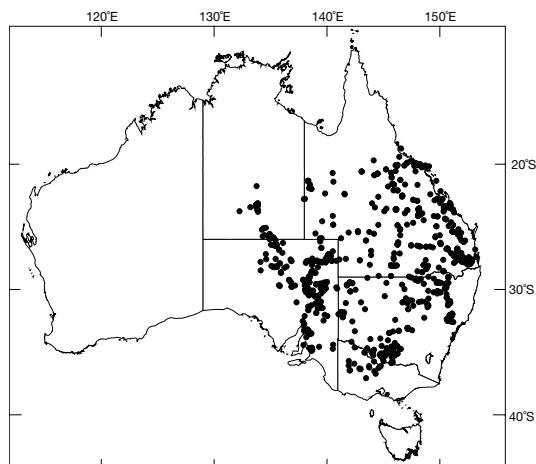
Related species: Cooba (sect. *Phyllodineae*) is related to salt wattle (*A. ampliceps*) a small riparian tree, which occurs in the tropics of Northern Territory and Western Australia. It differs mainly by its 2 to 11-headed racemes, its white to cream flower heads and its narrower pods. Seedling phyllodes are falcate in salt wattle and straight in cooba.

Publication: In T.L. Mitchell, *Three Exped. Australia* 2, 20 (1838). Type: Subtropical New Holland (near Oxley on the Lachlan River, New South Wales), 30 Mar. 1836, T.L. Mitchell 45.

Names: Botanical—Latin *salix*, *salicis* (a willow) alluding to its pendulous or weeping habit. Common—of Aboriginal origin.

Bark: Rough, fissured, somewhat scaly, brown weathering to grey-brown, upper branches becoming smooth, relatively thin, grey-brown; tannin content high.

Foliage: Seedling—first leaf pair pinnate with 5–6 leaflet pairs, following leaf bipinnate, at about the fourth leaf stage the petiole elongates and flattens and a bipinnate leaf persists at the apex, completely phyllodinous by about the seventh leaf stage. Adult—phyllodes, pendulous, variable, linear to narrowly oblanceolate or narrowly elliptic, 4–20 × 0.4–3.0 cm, green to grey-green, sometimes glaucous, glabrous, 1-veined, penninerved; glands 2–5, lowermost 0–5 mm above pulvinus.



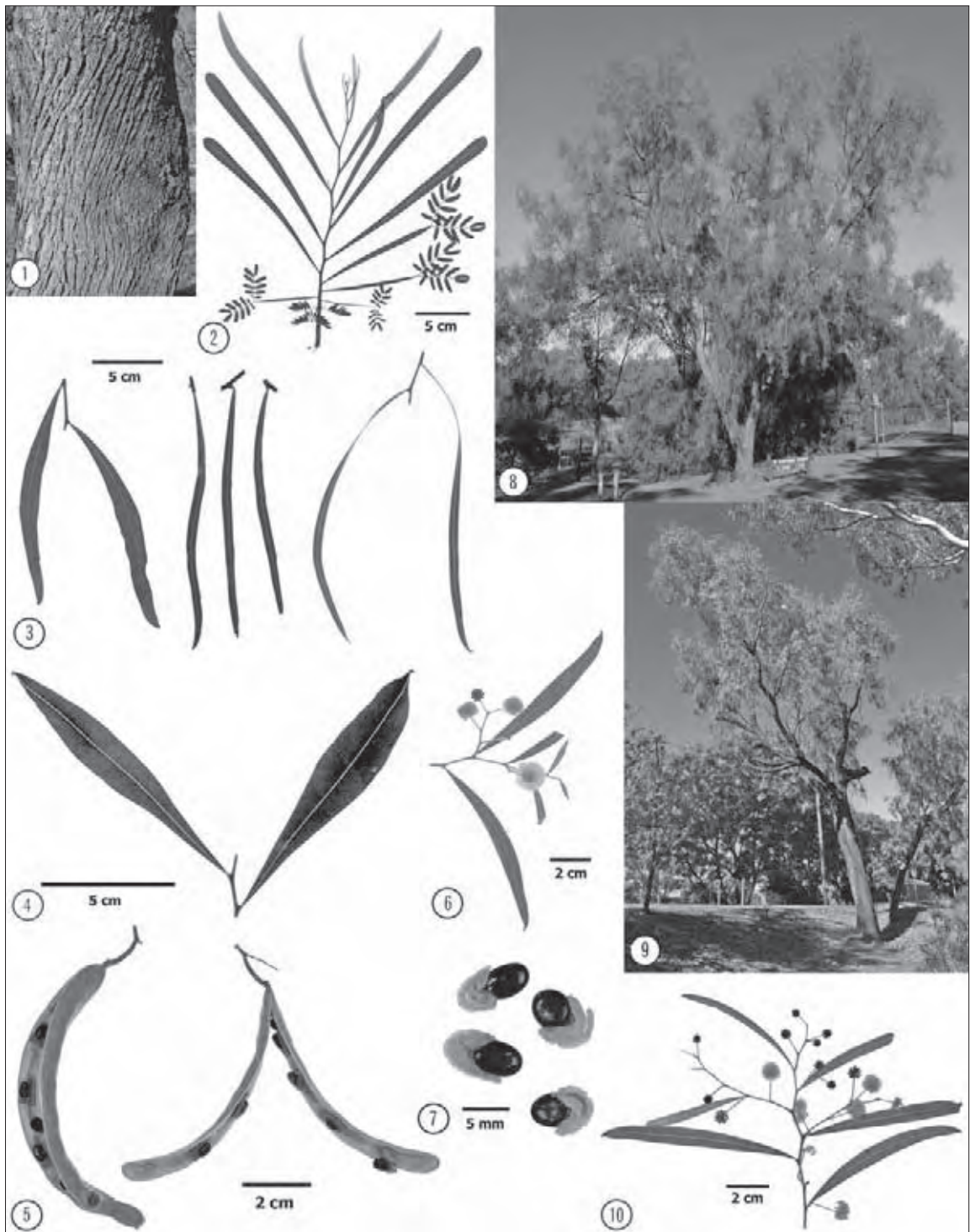
Inflorescences: Racemes, 2 to 8-headed, 1–5 cm long, peduncles glabrous, heads globular, 15 to 25-flowered, cream to pale yellow; flowers 5-merous, sepals fused. Flowers Apr.–Jun.

Fruits: Pods, narrowly oblong, 4–12 × 7–1.3 cm, woody, longitudinally striate when dry, dehiscent from the apical end at maturation. Seeds longitudinally aligned in pod, elliptic to oblong-elliptic, glossy, dark brown to black with a fleshy, scarlet aril. Usually a shy seeder, pods mature asynchronously mainly during Sept.–Nov.

Wood: Sapwood pale yellow-brown, heartwood dark reddish brown, attractively marked, close-grained, tough and moderately heavy, density 675 kg m⁻³; takes a high polish and in the past has been used for quality furniture as well as cart shafts, bullock yokes and Aboriginal people used it for boomerangs.

Climate: Altitudinal range: near sea level to around 600 m; Hottest/coldest months: 32–36°C/mainly 4–8°C; Frost incidence: low to moderate (1–12 per year in non-coastal areas); Rainfall: 125–550 mm per year, summer max. in the north to uniform and winter max. in the south of its range.

Distinctive features: Riverine or floodplain tree or large shrub with a dense crown of pendulous foliage; phyllodes highly variable in shape, uninerved, with 1–5 glands; pods thick, woody which dehisce apically; seeds with a large, fleshy scarlet aril.



Acacia salicina 1 Bark 2. Seedling 3. Variation in adult phyllodes 4. Juvenile phyllodes 5. Pods 6, 10. Flowering sprigs 7. Seeds 8. Tree, Lake Glenbawn, N.S.W. 9. Tree, MacIntyre River, Goondiwindi, Qld

Coojong Golden Wattle, Golden Wreath Wattle, Orange Wattle

Acacia saligna (Labill.) H. Wendl.

Coojong is usually a shrub or small tree up to 5 m in height, but given the right conditions it may be more arborescent attaining 10 m in height with a dbh to 50 cm. The trunk may be well developed but more commonly it is short, crooked and branches low to ground level. The adult crown is often densely foliated.

This species is endemic to the south-west of Western Australia. It is wide ranging extending from the Murchison River near Kalbarri and Sanford River near Yalgoo in the north, south to the Esperance region, with the eastern extent of its distribution bounded approximately by the 300 mm isohyet. It has become naturalised in south-eastern Australia with occurrences south from south-eastern Queensland to Tasmania and west to South Australia.

Coojong is usually found on depositional sites low in the topography. Sites include creeks and riverbanks, on run-on sites at the base of rock outcrops and on the interdune swales of coastal sand dune systems. Soils include sands, sandy loams or sandy clays, which are sometimes moderately saline at depth, and range from acidic to alkaline. They are derived from a range of substrates including limestone, granite, laterite and alluvium.

This species grows in woodlands, open woodland and sometimes in open forests. It is associated with numerous species that occur on depositional sites throughout the south-west, and include tuart (*E. gomphocephala*), river gums (*E. rudis*, *E. camaldulensis*) and flat-topped yate (*E. occidentalis*).

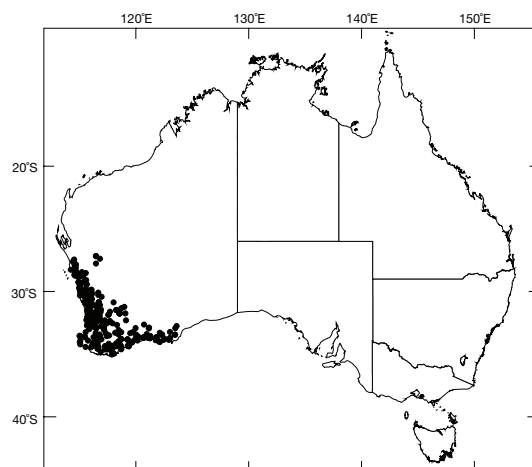
Related species: The affinities of coojong (section *Phyllodineae*) are obscure. It is not particularly close to *A. pycnantha*, a species with which it is sometimes confused. The large, disk-like basal gland and raceme buds enclosed by imbricate bracts are some of the traits that readily distinguish coojong from this species. Four informal variants of coojong were documented in Maslin and McDonald (2004).

Publication: *Comm. Acac. Aphyll.* 4, 26 (1820). Type: Terra Diemen. herb. Webbium. Ex herb. Labillardière [see Maslin, *Nuytsia* 1, 334 (1974) for discussion regarding the type].

Names: Botanical—Latin *salignus* (willow or willow-like), an allusion to the foliage drooping like some species of willow (*Salix*). Common—of Aboriginal origin.

Bark: Either hard and furrowed longitudinally or friable and forming a rectangular fracture or rough at base, smooth above on shrub forms.

Foliage: Cotyledons—opposite, oblong, early caducous. Seedling—alternate, petiolate, first two leaves pinnate with 4–7 pairs of leaflets, second to sixth leaf phase bipinnate on long petioles with 4–7 pairs of leaflets, next phase phyllodinous with a bipinnate leaf persisting at its apex, thereafter completely phyllodinous. Intermediate phyllodes—much larger than adult phase, up to 40 cm long and up to 10 cm wide, ranging from pruinose, bluish and dull to non-pruinose, green and shiny. Adult phyllodes—highly variable in shape, ranging from linear, narrowly elliptic to broadly elliptic and from straight to falcate, 4–22 × 0.4–6 cm, bluish-green or



green, pruinose or non-pruinose, dull or shiny; gland relatively large and disk-shaped, usually positioned at the distal end, or sometimes up to 0.5(–1) cm from the pulvinus.

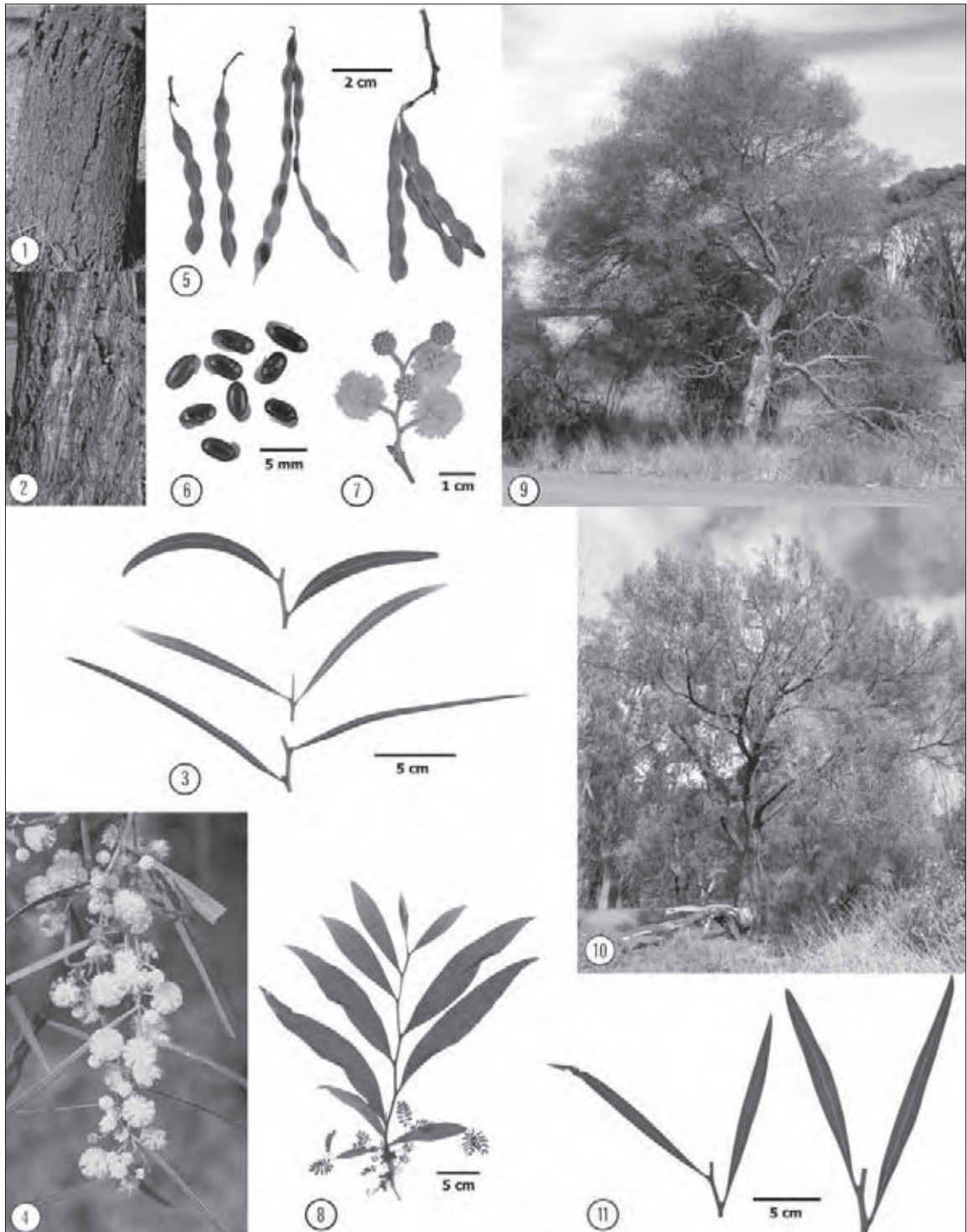
Inflorescences: Axillary racemes (or rarely terminal), 2 to 10(–13)-headed, 0.3–6.5 cm long, peduncles 0.5–1.5 cm long, heads 25–55(–78)-flowered, golden; flowers 5-merous, sepals fused. Flowers Jul.–Oct.

Fruits: Pods, linear, very slightly moniliform, 8–14 × 0.4–0.7 cm, thinly coriaceous. Seeds longitudinally aligned in pod, oblong-elliptic, glossy, dark brown to black, aril cap-like. Mature Nov.–Jan.

Wood: Heartwood pale yellow, hard, density 600 kg m^{–3}; currently being assessed for its potential to produce biomass for energy production, wood composite products and industrial charcoal.

Climate: Altitudinal range: near sea level to 325 m with isolated occurrence higher; Hottest/coldest month: 23–36°C/4–9°C; Frost incidence: low to moderate (1–6 per year at inland sites); Rainfall: 300–1000 mm per year, winter max.

Distinctive features: A shrub or small tree with larger juvenile foliage compared to adult foliage; phyllodes with a one central nerve and a relatively large disk-like basal gland; inflorescences in racemes with golden-yellow flower heads, racemes enclosed by imbricate bracts when young.



Acacia saligna 1, 2. Bark variation 3. Adult phyllode variation 4. Flowering sprig 5. Pods 6. Seeds
7. Inflorescence 8. Seedling 9. Tree, Jerdacutlup River, W.A. 10. Tree, Perry Lakes, Perth, W.A. 11. Adult
phyllode variation

Lancewood Shirley's Lancewood

Acacia shirleyi Maiden

Lancewood is a tree up to 18 m in height with a dbh up to 50 cm. The bole is usually straight, well developed and often over half the tree height. The crown typically has ascending branches with crowded foliage.

This species has a widespread but scattered, discontinuous occurrence across inland north-eastern Australia. It extends from north of Towoomba in south-eastern Queensland, to the base of Cape York Peninsula and the Mt Isa area in north Queensland and west to the Victoria River region of Northern Territory.

Lancewood is restricted to low lateritic or sandstone outcrops. Soils are usually shallow, acidic sandy loams.

This species typically grows in pure stands in open forests or woodlands. Some stands are very densely spaced and a lower shrub or ground cover stratum may be absent. Many stands of lancewood are even-aged having established from large seedling recruitment events following bushfire.

Related species: Lancewood (sect. *Juliflorae*) has affinities with a number of species that include *A. catenulata*, *A. doratoxylon*, *A. distans*, *A. granitica*, *A. petrea* and *A. sparsiflora*. As well as having morphological affinities, these species also share similar habitat specificity, as all are restricted in occurrence to various types of rock outcrops.

Publication: J. & Proc. Roy. Soc. New South Wales 53, 218, pl. 15, figs 8–14 (1920). Type: Mt Rose, Eidsvold, Queensland, 7 Nov. 1912, T.L. Bancroft 14.

Names: Botanical—after Dr. J.F. Shirley (1849–1922), an Inspector of Schools in Queensland with an interest in botany. Common—refers to wood, which readily splits into large, lance-like splinters.

Bark: Rough, fibrous, shallowly fissured, brown weathering to grey or dark grey.

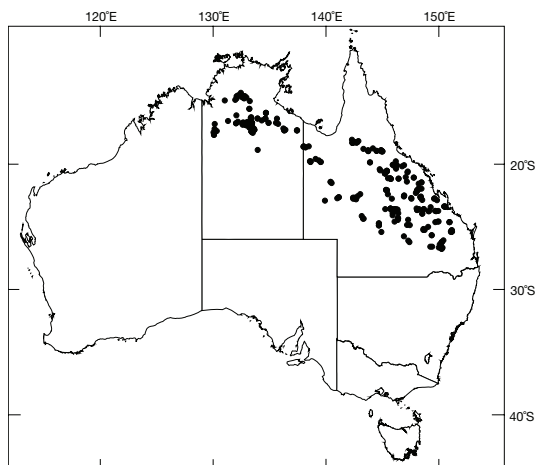
Foliage: Cotyledons—elliptic or obovate, 4 mm long. Seedling—first leaf pinnate with 3 leaflet pairs, second leaf bipinnate, at the fourth or fifth leaf stage the petiole elongates and flattens with a bipinnate leaf persisting at the apex, thereafter phyllodinous. Adult—phyllodes, straight or shallowly curved, 8–19 × 0.2–1 cm, coriaceous, green, midnerve more prominent than the rest, minor nerves inconspicuous, close together, parallel; gland basal. The foliage is palatable to stock.

Inflorescences: Axillary spikes, 1.5–6 cm long, flowers scattered along rachis, lemon yellow; flowers 5-merous, sepals partially fused, hairy. Flowers Mar.–Jun.

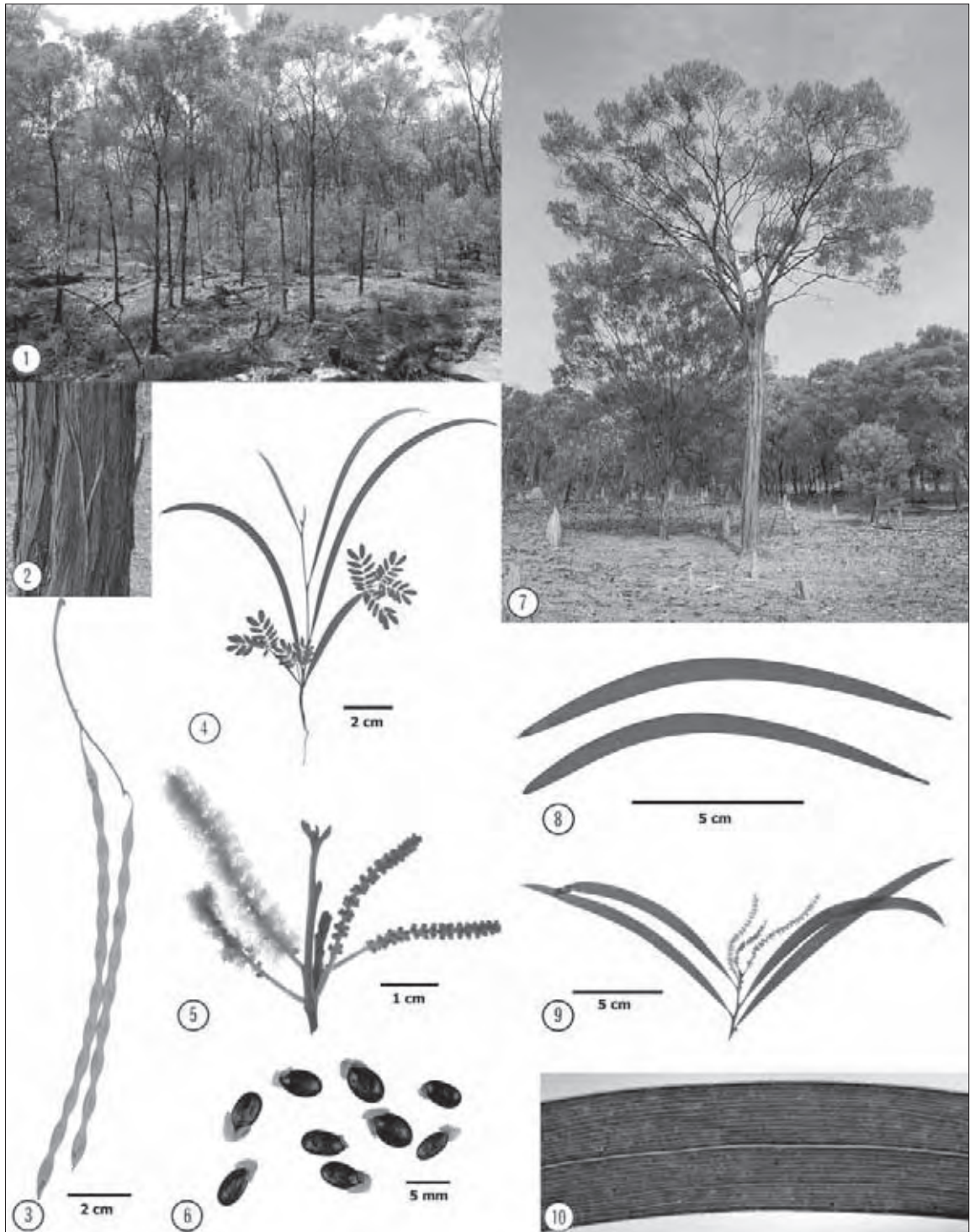
Fruits: Pods, linear, constricted between and raised over seeds, 6–12 × 0.3–0.5 cm, crustaceous, longitudinally wrinkled. Seeds longitudinally aligned in pod, broadly elliptic, black. Mature Sept.–Dec.

Wood: Heartwood pale reddish brown, density 1020–1050 kg m⁻³, not durable in the ground, prone to splitting; used for fence rails. The wood has potential for a number of industrial uses, including flooring and veneer.

Climate: Altitudinal range: near sea level to 750 m; Hottest/coldest months: 31–34°C/15–22°C; Frost incidence: low; Rainfall: 1200–3600 mm per year, summer max.



Distinctive features: A tree usually occurring in dense pure stands on sandstone or laterite rock outcrops; branches ascending; phyllodes with inconspicuous, parallel, minor nerves but a more conspicuous midnerve; pods narrowly linear.



Acacia shirleyi 1. Stand, near Tambo, Qld 2. Bark 3. Pods 4. Seedling 5. Inflorescence 6. Seeds 7. Tree, Mountain Valley Station, N.T. 8. Adult phyllodes 9. Flowering sprig 10. Phyllode nervation

River Cooba Eumong, Munumula, Balkura, Gurley, Gooralee, plus many others

Acacia stenophylla A. Cunn. ex Benth.

River cooba is a tall shrub or tree usually 5–15 m in height or sometimes taller. The dbh is in the range of 20–40 cm and the bole often forms a dominant proportion of the tree height. The crown foliage is relatively long, narrow and often pendulous. Regrowth from root suckering may often be observed in proximity to the trunk.

This is a widespread species occurring in all mainland States. It extends throughout much of the Murray–Darling and Lake Eyre drainage basins. This includes most of inland Queensland, the western half of New South Wales, the far north-western fringe of Victoria and parts of north-eastern and south-eastern South Australia. It is scattered across latitudes 17–18°S of Northern Territory extending west to the Sturt Creek and Gordon Downs region of north-eastern Western Australia. A highly disjunct outlier is known from north of Wittenoom in the Pilbara region of Western Australia.

Throughout its range river cooba grows along the banks of rivers and creeks or sometimes extending to floodplains. Soils are usually heavy textured, alluvial clays. They are often alkaline and sometimes saline. The alluvial soils may be derived from a wide range of rock types.

Vegetation structure ranges from open forests to low open woodlands. It is associated with a range of other riparian species, including river red gum (*E. camaldulensis*), coolibah (*E. coolabah*), black box (*E. largiflorens*), cooba (*A. salicina*) and myall (*A. pendula*).

Related species: River cooba (sect. *Plurinerves*) is not considered particularly close to any other species but may be confused with wirewood (*A. coriacea* subsp. *sericophylla*), which occurs across a similar range, usually on sandplains. Wirewood differs in having minutely hairy phyllodes with more closely spaced nerves and pods that dehisce to reveal seeds partially capped by a large, fleshy yellow-orange aril.

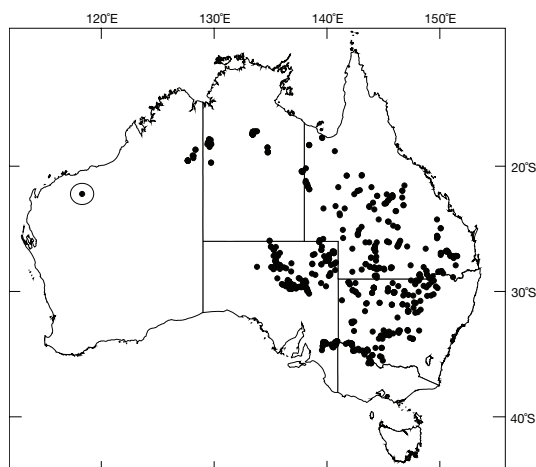
Publication: *London J. Bot.* 1, 366 (1842). Type: New Holland, Lachlan River, New South Wales, Jun. 1817, A. Cunningham.

Names: Botanical—Greek *stenos* (narrow, straight), *phyllon* (a leaf) alluding to its long linear phyllodes. Common—refers to its habitat along rivers while *cooba* is of Aboriginal origin.

Bark: Rough, longitudinally fissured, relatively thin, brown weathering to grey-brown.

Foliage: Seedling—first leaf pinnate with 5–6 leaflet pairs, second leaf bipinnate, at the third leaf stage the petiole elongates and flattens with a bipinnate leaf persisting at the apex, phyllodinous by about the fifth leaf stage. Adult—phyllodes, pendulous, linear, 15–40 × 0.2–0.7 cm, coriaceous, green to grey-green, nerves numerous, parallel, obscure except central nerve slightly more prominent, apex, acute, hooked.

Inflorescences: Racemes, 1 to 6-headed, 0.1–1.5 cm long, hairy or rarely glabrous, peduncles 0.6–1.3 cm long, heads globular, 20 to 40-flowered, creamy white to pale yellow; flowers 5–merous, sepals fused. Flowers mainly during winter, but often irregularly throughout the year.

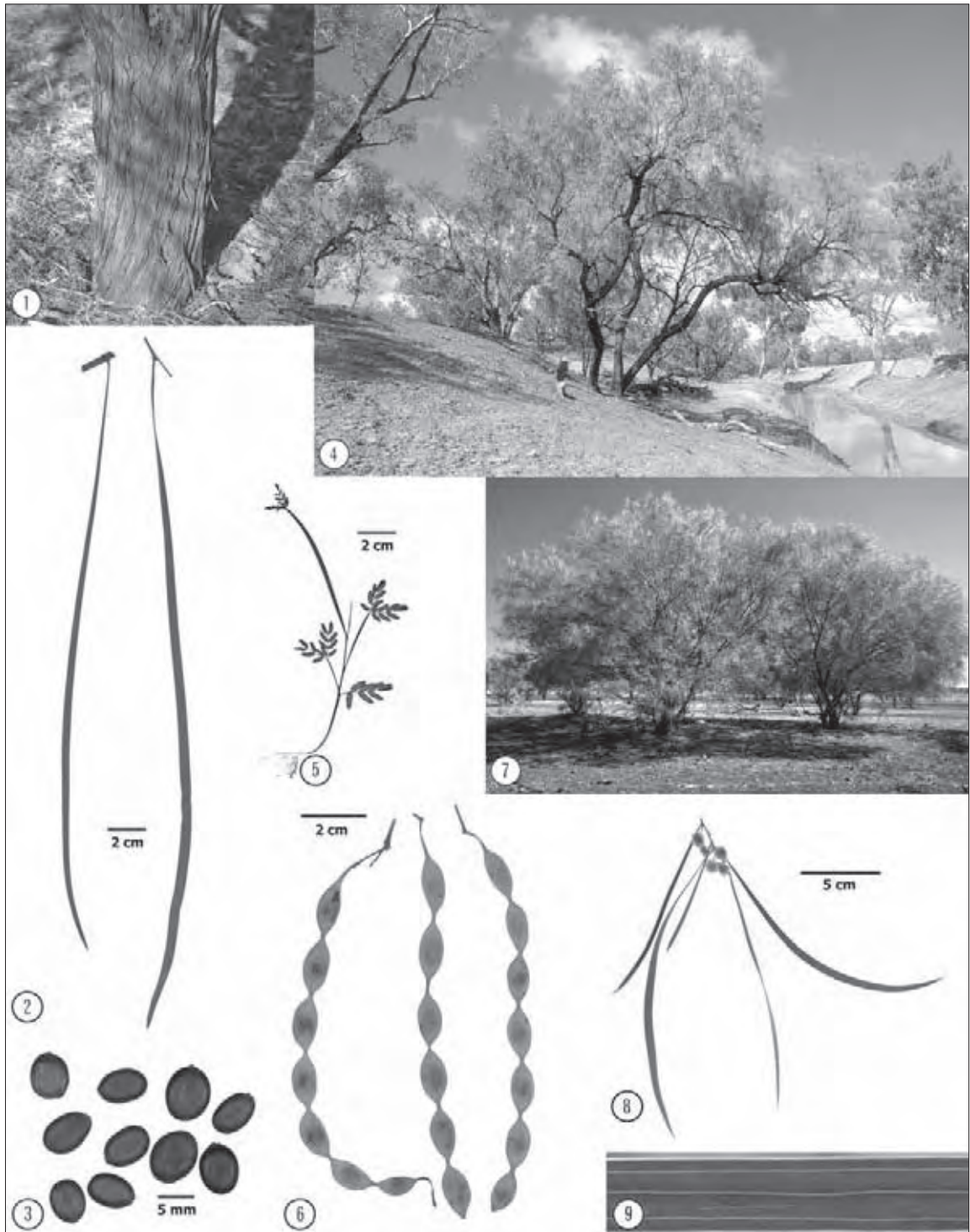


Fruits: Pods, moniliform, 10–26 × 0.6–1.2 cm, woody. Pods are more or less indehiscent, readily breaking at constrictions between seeds, which is thought to aid dispersal by enabling the seed to float. Seeds longitudinally aligned in pod, broadly elliptic to oblong-elliptic, dark brown, funicle cream, aril small, obscure. Mature Sept.–May.

Wood: Sapwood pale yellow-brown, heartwood dark brown, close-grained, attractively marked and takes a fine polish, density 900–960 kg m⁻³; used for fence posts, craftwood and furniture but availability is limited.

Climate: Altitudinal range: near sea level to around 625 m; Hottest/coldest months: 35–38°C/4–7°C; Frost incidence: low to moderate (1–20 per year); Rainfall: 125–600 mm per year, summer max.

Distinctive features: Riverine tree or large shrub usually with pendulous foliage; phyllodes linear to 40 cm long, with numerous parallel, longitudinal nerves; pods moniliform, woody, more or less indehiscent, readily breaking at constrictions between seeds; seeds brown with an inconspicuous cream aril.



Acacia stenophylla 1. Bark 2. Adult phyllodes 3. Seeds 4. Tree, Bogan River, N.S.W. 5. Seedling 6. Pods 7. Stand, Nongra Lakes, N.T. 8. Flowering sprig 9. Phyllode nervation

Wongai Pindan Wattle, Sick-leaf Wattle, Spear Wattle

Acacia tumida F. Muell. ex Benth.

Wongai varies from a prostrate shrub to erect tree up to 15 m in height with a dbh to 40–50 cm. The bole of the tree form is usually less than half the tree height. The crown typically has ascending branches with relatively large, sometimes pendulous phyllodes. The shrub form is typically multi-stemmed from ground level. Foliage colour varies from glossy green to blue-green.

This species is common across north-western Australia extending from the Victoria River region in Northern Territory, west throughout the Kimberley and Pilbara regions of Western Australia. There are limited occurrences in the Tanami and Great Sandy Deserts fringing its main occurrence.

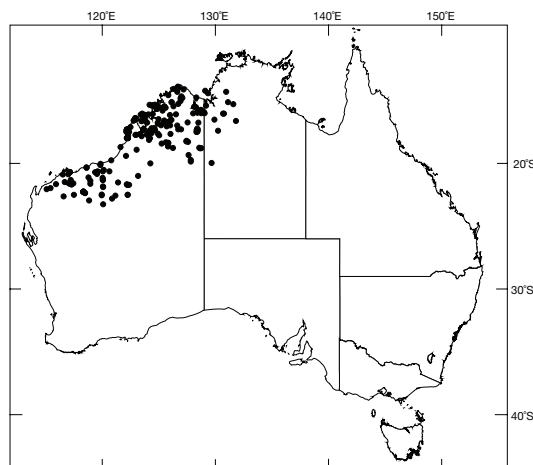
Wongai occurs on a wide range of depositional land-forms including along creeks and valleys, on or near rock outcrops, on upper slopes and ridges, on sand dunes or plains or along the edges of disturbed roadsides. Soils are acidic, diverse and include sands, sandy loams, loams and clay loams, derived from substrates such as quartzite, sandstone, granite, laterite, schist and basalt.

This species typically grows in open woodlands associated with a range of eucalypts, particularly bloodwoods, and other wattles such as *A. colei*, *A. monticola*, *A. platycarpa* and *A. eriopoda*. It often forms even-aged, pure stands that have established from seedling recruitment events following bushfire.

Related species: Wongai (sect. *Juliflorae*) belongs to a group that includes *A. areolata*, *A. brassii*, *A. eriopoda*, *A. difficilis*, *A. meiosperma*, *A. moutfordiae*, *A. retinervis*, *A. seclusa* and *A. torulosa*. It has closest affinities with *A. difficilis* which differs mainly in having reddish brown, fibrous bark extending to the lower branches and pods only 3–4 mm wide with longitudinally aligned seeds. Wongai may also be confused with *A. retinervis* which differs mainly in having phyllodes with minor nerves that form a close, elongated reticulum, simple, 2 per axil inflorescences, laterally compressed seeds and by sometimes maintaining hairy juvenile foliage on mature trees. McDonald (2003) revised the 'A. tumida group' and recognised a number of new taxa including four varieties of wongai. These are—var. *tumida*, which mainly occurs in the Kimberley region of Western Australia and adjacent areas of Northern Territory, and is usually a single-stemmed tree with a well-developed trunk and a dense crown of large, lanceolate-falcate phyllodes; var. *kulparn*, which occurs in the Tanami Desert—Great Sandy Desert—Eighty Mile Beach region, and is a multi-stemmed shrub branching from ground level with 4–6 stems, producing short, dimidiate phyllodes; var. *pilbarensis*, which occurs in the Pilbara region, and narrow, often strongly falcate phyllodes; and var. *extenta* from Mt Trafalgar in the Kimberley, which is a wispy small tree with long narrow phyllodes and narrow pods.

Publication: *Fl. Austral.* 2, 409 (1864). Type: Point Pearce, Victoria River, Northern Territory, Dec. 1855, F. von Mueller 100.

Names: Botanical—Latin *tumidus* (swollen, thickened) presumably alluding to the thickened, woody pods. Common—of Aboriginal origin.



Bark: Lower bark hard, platy, longitudinally fissured, grey; upper bark smooth, normally lightly to densely pruinose.

Foliage: Seedling—first leaf pinnate with 3 leaflet pairs, second leaf bipinnate, at the third and fourth leaf stage the petiole elongates and flattens with the bipinnate leaf persisting at the apex, phyllodinous by the sixth leaf stage. Juvenile—phyllodes, dimidiate, densely hairy, hairs silvery-white. Adult—phyllodes, falcate to subfalcate or dimidiate, 6–25 × 0.7–6 cm, coriaceous, pruinose or non-pruinose, green to blue-green, longitudinal nerves numerous, parallel, 3 nerve more prominent than the rest, 3–4 less prominent secondary nerves minor nerves inconspicuous, close together, gland basal, small.

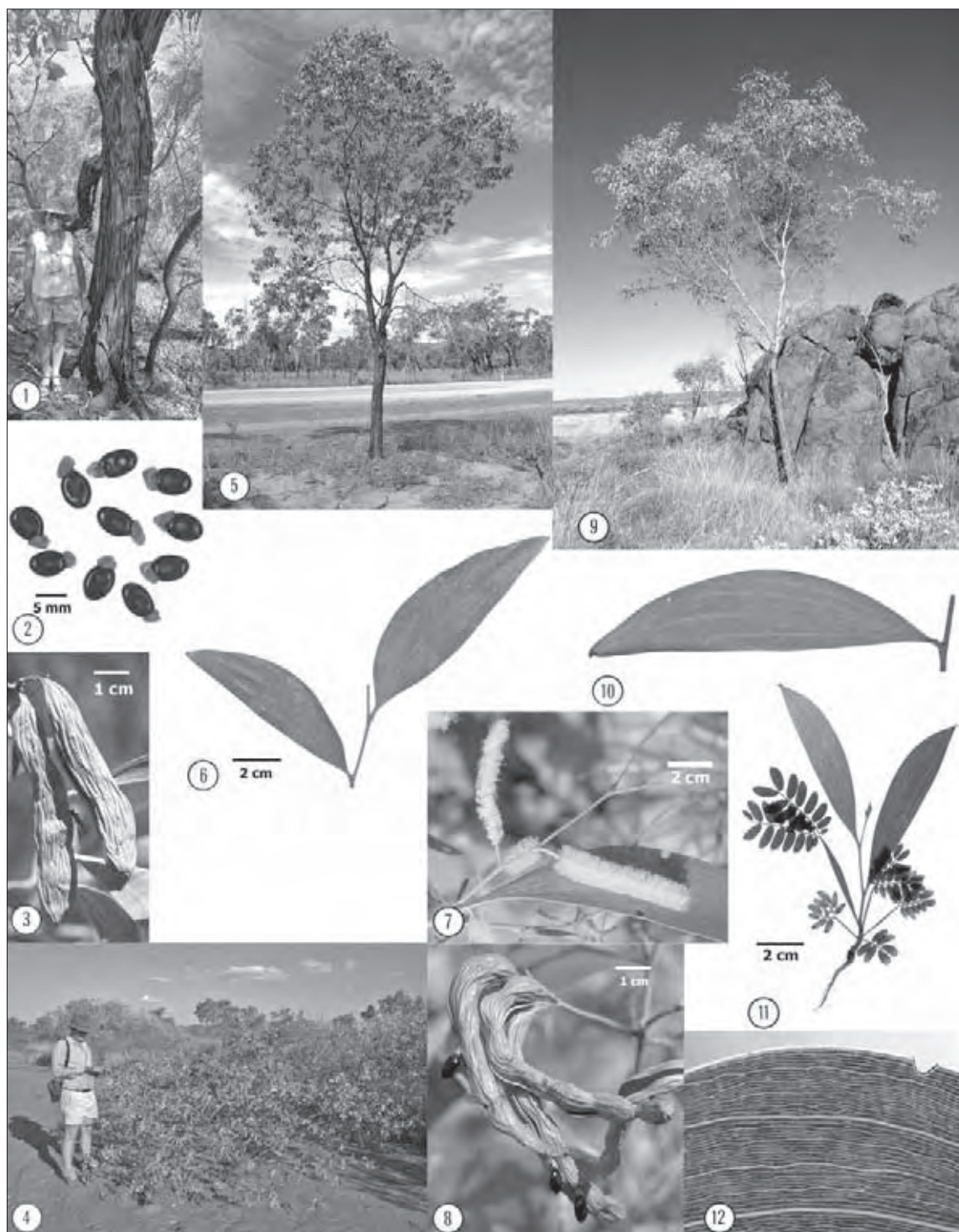
Inflorescences: Axillary or terminal racemes or sometimes terminal panicles, 0.5–20 cm long, peduncles 0.2–1 cm long, spikes 1 (–2) per raceme node, flowers densely arranged along rachis, yellow to golden; flowers 5-merous, sepals partially fused, hairy. Flowers May–Aug.

Fruits: Pods, narrowly oblong, more or less terete, 3.5–12 × 0.3–1.2 cm, woody, longitudinally wrinkled. Seeds obliquely aligned in pod, ellipsoid, glossy, black or occasionally brown, aril twice-folded, cream. Mature Sept.–Nov.

Wood: Heartwood brown, density unknown. Produces good firewood.

Climate: Altitudinal range: near sea level to 500 m; Hottest/coldest months: 34–42°C/10–20°C; Frost incidence: low (but some may occur at high elevation sites); Rainfall: 450–1000 mm per year, summer max.

Distinctive features: Low shrub or small tree usually with relatively large falcate or dimidiate phyllodes; phyllodes with numerous, inconspicuous, parallel nerves and 3–7 more conspicuous main nerves; inflorescences in axillary or terminal racemes or sometimes terminal panicles, up to 20 cm long, spikes usually 1 per node, yellow or golden; pods woody, more or less terete, up to 1.2 cm wide with seeds aligned obliquely in the pod.



Acacia tumida: var. *tumida* (t), var. *kulparn* (k), var. *pilbarensis* (p) 1. Bole and bark (t) 2. Seeds 3. Pods (t) 4. Shrub, near Fitzroy Crossing, W.A. (k) 5. Tree, near Kununurra, W.A. (t) 6, 10. Juvenile phyllodes 7. Inflorescence 8. Pods (k) 9. Tree, Spear Hill, W.A. (p) 11. Seedling 12. Phyllodes nervation

Gundabluey

Narran, Prickly Wattle (N.S.W.), Elegant Wattle (S.A.), Bramble Wattle (Qld.), Acacia Bush (N.T.), Bardi Bush (W.A.)

Acacia victoriae Benth.

Gundabluey is usually a spreading, shrub 2–5 m tall or sometimes a tree up to 8 m in height. Bole formation is rare with branching close or near to ground level. The canopy is much branched and the branches are smooth and notably pale green. The branchlets often have small spiny stipules that subtend the phyllodes, earning it one of its common names—prickly wattle.

Gundabluey is a widespread species that occurs in the arid and semi-arid zones of all mainland States. It extends from the Pilbara, Gascoyne and Murchison region of Western Australia east through central Australia to the Gulf of Carpentaria and to subcoastal Queensland (e.g. near Townsville). It extends as far south as the Adelaide area in South Australia, the Sunset Desert region in Victoria and the Western Plains of New South Wales.

This species grows on a range of sites but in many parts of its range it is most commonly found on flood-plains, alluvial flats or similar depositional landforms. In some areas, such as the southern occurrences in South Australia, it grows on rocky hillsides and ridges. Soils range from clayey alluvials and grey cracking clays to saline loams and are often alkaline.

Gundabluey is commonly found in open shrublands or open woodlands. Associated eucalypts include river red gum (*E. camaldulensis*), coolibah (*E. coolabah*), tjuta (*E. terminalis*), kopi gum (*E. striatocalyx*), black box (*E. largiflorens*), while other wattles include mulga (*A. aneura*), limestone wattle (*A. sclerosperma*), dead finish (*A. tetragonophylla*), Georgina gidgee (*A. georginae*) and snakewood (*A. xiphophylla*).

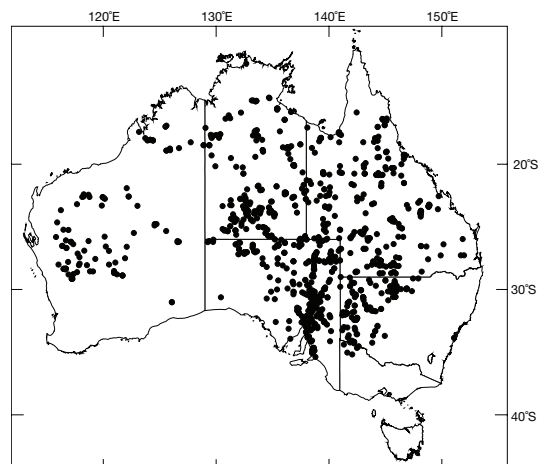
Related species: Gundabluey (sect. *Phyllodineae*) belongs to a group that comprises 10 species revised by Maslin (1992). *Acacia synchronicia*, from the Pilbara and Kimberley regions of Western Australia, differs in having longer phyllodes, simple inflorescences and golden flower heads, and *A. glaucocaesia*, from the Fortescue and DeGrey Rivers region in Western Australia, differs in having stipules consistently absent from mature phyllodes and more densely clustered flower heads (35 to 50-flowered). *Acacia alexandri* from Cape Range near Exmouth, Western Australia, has much longer, narrow phyllodes and simple inflorescences. Pedley (1978) recognised *A. victoriae* subsp. *arida*, based on its densely hairy branchlets and phyllodes and its occurrence on sandy soils in the lower Diamantina River–Cooper Creek catchment and Simpson Desert regions.

Publication: In T.L. Mitchell, *J. Exped. Trop. Australia* 333 (1848). Type: Barcoo River (at the time called the Victoria River), Queensland, 1 Oct. 1846, T.L. Mitchell 620.

Names: Botanical—named after the river in central Queensland which at the time was called the Victoria River but is now known as the Barcoo River. Common—of Aboriginal origin.

Bark: Finely fissured, brown, upper branches smooth, thin, greenish, often with a pruinose bloom.

Foliage: Seedling—first leaf pinnate with 4–6 leaflet pairs, bipinnate from the second leaf on for a numerous and variable



number of nodes, until finally phyllodinous. Adult—phyllodes, linear to narrowly oblong, lanceolate or narrowly elliptic, 2–5 × 0.2–0.8 cm, green to grey-green or blue-green, midnerve prominent with one basal gland.

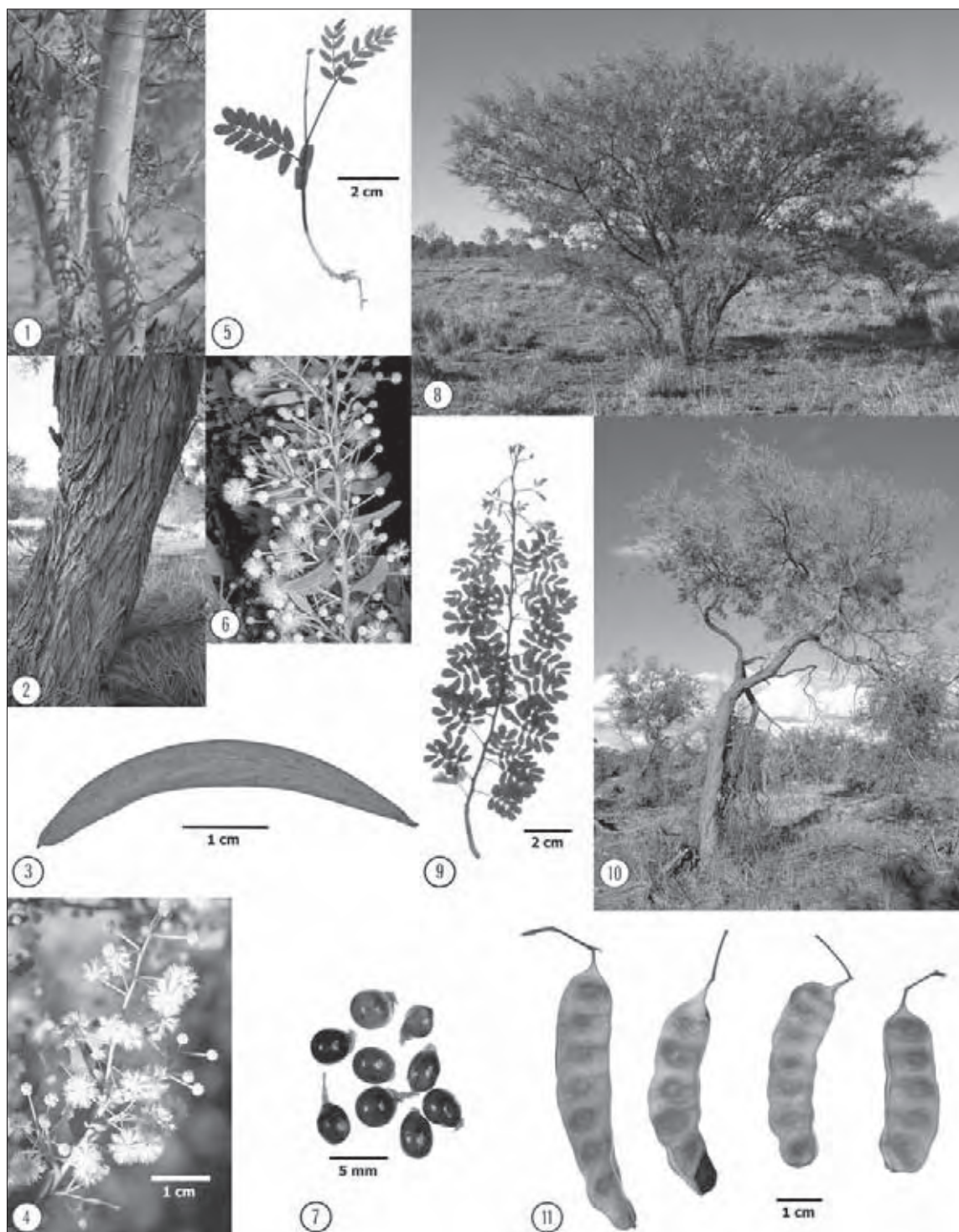
Inflorescences: Racemes, 1–10 cm long, slender, peduncles mostly in pairs, flower heads globular, 15 to 30-flowered, creamy white to pale lemon-yellow; flowers 5-merous, sepals free. Flowers Aug.–Dec.

Fruits: Pods, narrowly oblong, to 8 × 0.9–1.6 cm, chartaceous, flat but convex over the seeds. Seeds transversely aligned in pod, globose, mottled brown and black, aril obscure. Mature (Oct.) Nov.–Dec. (Mar.).

Wood: Sapwood whitish, heartwood dark brown and not well developed, density about 800 kg m⁻³, lightweight relative to its volume; uses are limited due to its small size but provides good firewood.

Climate: Altitudinal range: 50–750 m; Hottest/coldest months: 35–39°C/5–10°C; Frost incidence: low to moderate (1–11 frosts per year); Rainfall: 125–1000 mm per year, summer max., uniform or winter max.

Distinctive features: Usually a many-branched shrub with paired, pungent stipules subtending the phyllodes; upper branches pale green; phyllodes highly variable in dimensions and colour which ranges from green to blue-green; flowers cream to pale yellow produced in crowded racemes; pods oblong, papery, usually produced in profusion. The foliage is readily eaten by stock when other feed is scarce; phyllode crude protein content and digestibility reported to be relatively high. Seeds are edible and used to make wattleseed flour by the native bush food industry.



Acacia victoriae 1. Upper bark 2. Lower bark 3. Adult phyllode 4, 6. Flowering sprigs 5. Young seedling 7. Seeds 8. Tree, near Boulia, Qld 9. Seedling 10. Tree, Gol Gol, N.S.W. 11. Pods

Southern Sassafras

Atherosperma moschatum Labill.

Southern sassafras is a small to medium-sized tree usually 10–15 m in height but occasionally reaching 25 m and up to 0.75 cm in diameter. Young trees are generally of good form with straight trunks, horizontal branches and conic crowns of dark green, shining leaves. Older trees have open crowns with decumbent lower branches. Layering often produces groups of stems.

This species is widely distributed on cool moist sites in south-eastern Australia, from southern Tasmania to the Barrington Tops area of New South Wales.

It is found mainly in gullies and along creek lines on the mainland and extends up valley sides in East Gippsland, Victoria, but is much more widespread in Tasmania, especially in the western region. Soils are often fairly deep clay loams with a thin organic horizon. They are derived from intermediate igneous rocks such as granodiorite or dacite, or Silurian and older sediments.

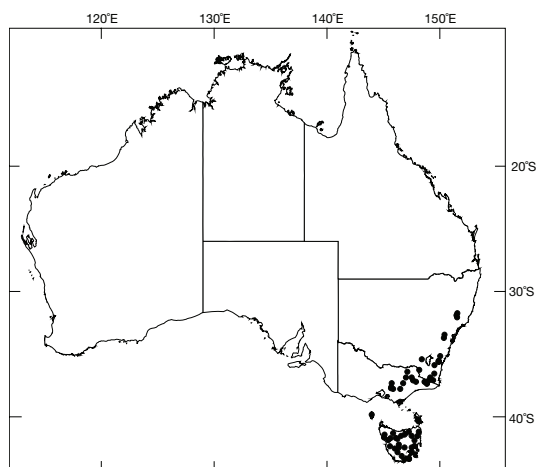
Southern sassafras is a subsidiary species in cool temperate rainforests. In Tasmania it is common in the myrtle beech (*Nothofagus cunninghamii*) dominated forests of the west coast and in mixed forests of celery top pine (*Phyllocladus aspleniifolius*) and leatherwood (*Eucryphia lucida*). Occasionally southern sassafras is found in more or less pure stands with manfern (*Dicksonia antarctica*). In Victoria it is associated with myrtle beech (*Nothofagus cunninghamii*), blackwood (*Acacia melanoxylon*), pittosporum (*Pittosporum bicolor*) and Australian mulberry (*Hedycarya angustifolia*). On Errinundra Plateau *Atherosperma* occurs beneath an over-storey of shining gum (*Eucalyptus denticulata*). In New South Wales it is more scattered. The species is usually found at altitudes of 1000–1200 m above occurrences of sassafras (*Doryphora sassafras*) and coachwood (*Ceratopetalum apetalum*).

Related species: There are about 35 genera in the family Monimiaceae, predominantly southern hemisphere in distribution, and 3 occur in Australia—*Atherosperma*, *Daphnandra* and *Doryphora*. Southern sassafras may be confused with sassafras (*Doryphora sassafras*), which has larger, coarsely toothed leaves green and glabrous on the undersurface, and stamens with long bristle-like tips.

Publication: *Nov. Holl. Pl.* 2, 74–5 (1806). Type: Tasmania, J.J.H. Labillardière.

Names: Botanical—*Atherosperma*, from the Greek *athere* (goat), plus *sperma* (seed), referring to the bearded carpels; *moschatum* from the Greek and Latin *moschos* (musk, musk-scented), alluding to the odour of the bark and branchlets. Common—probably after the laurels (*Sassafras* spp.) of North America, the woods of which have a similar fragrance to that of *Atherosperma moschatum*.

Bark: Light grey to light brown on the surface, with numerous lenticels. Branch scars are usually conspicuous and the surface may be covered by green or variously coloured lichens. The outer dead bark is thin, while the live bark, up to 2 cm thick, is mottled light brown and cream. The bark is aromatic, containing tannin, resin and an essential oil.



Leaves: Seedling—opposite, petiolate (0.2–0.5 cm long) and curved near junction with stem, elliptical, 1–5 × 0.5–2 cm, toothed (20–25 teeth), dark green above and white beneath; scattered hairs on both surfaces; nervation reticulate and visible on both leaf surfaces. Adult—opposite, petiolate (0.5–1 cm long), without stipules, lanceolate and acute, 3–5 × 1.5–2 cm, sparsely toothed or entire (Blue Mountains and Barrington Tops, New South Wales) pale green and shining on the upper surface, greyish green to grey-white with a fine indumentum beneath, fragrant as of nutmeg.

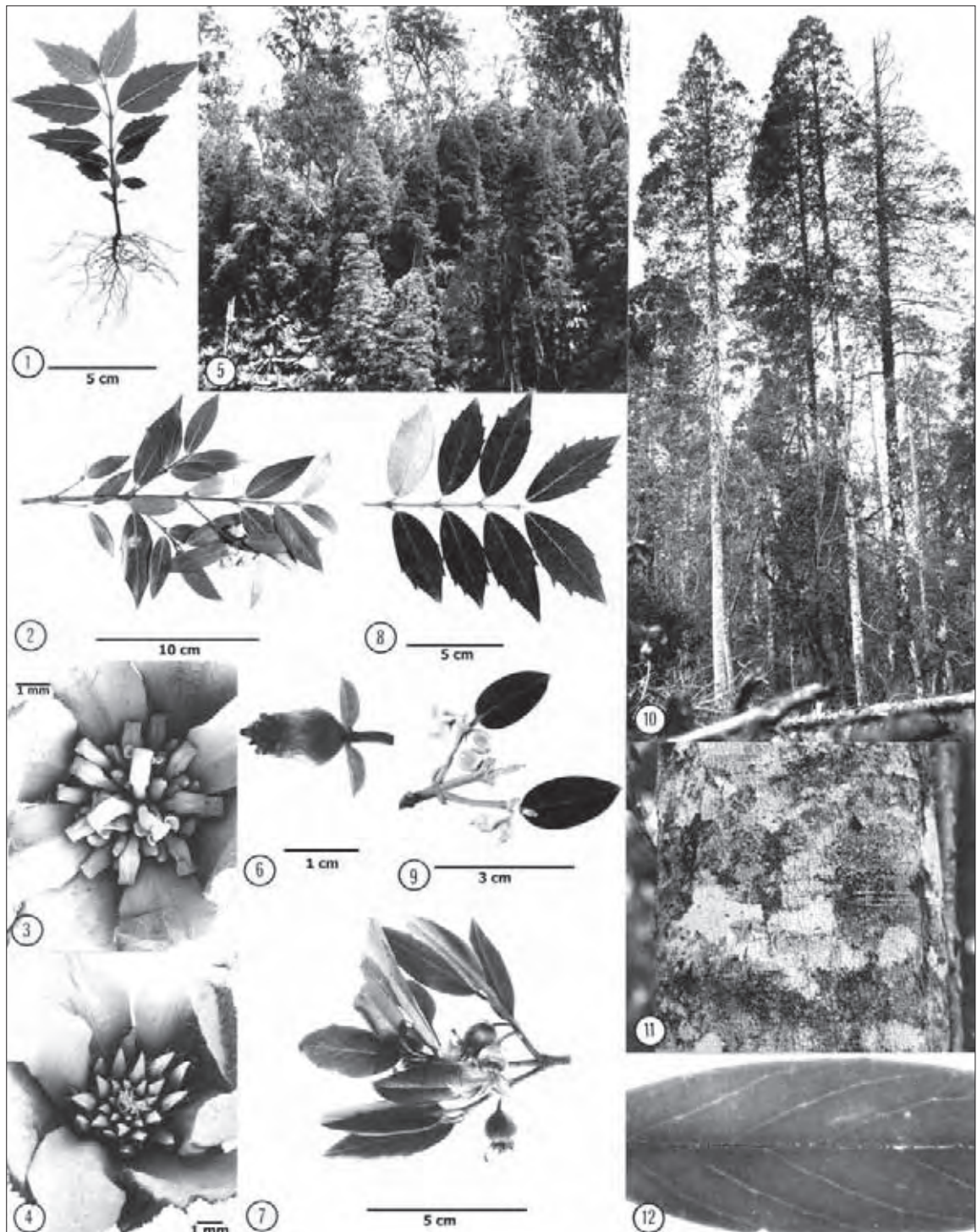
Inflorescences: Flowers are unisexual, monoecious, subtended by a pair of persistent large bracts appearing in winter. Male—have 8 white perianth segments in 2 whorls and 12–15 stamens, each with a pair of elongated nectaries (glands) at the base, on a broad flat or domed receptacle; anthers are truncate and open by 2 flaps which curl upwards. Female—have the same arrangement of perianth segments as male flowers but they surround a cup-shaped receptacle bearing 2–3 rows of staminodes around its margin and many carpels within, whose long, feathery styles project.

Fruits: Perianth segments soon fall and the receptacle enlarges to 0.8–1 cm diameter, enclosing the fruits (achenes) with the feathery styles persisting.

Wood: Sapwood pale; heartwood pale but sometimes pale grey to light brown, texture fine, straight-grained, soft, density 480–660 kg m⁻³. The heartwood is sometimes black, sometimes streaky with ‘tiger-cat’ figure, and ‘blackheart sassafras’ is in demand for turnery and other specialty work. The timber works well, bends and polishes excellently, and is easy to season.

Climate: Altitudinal range: near sea level to about 800 m (Tas.), 200–1375 m (mainland); Hottest/coldest month: 15–20°C/–2–5°C; Frost incidence: moderate to high (up to 50 frosts a year with snowfalls each year at higher altitudes); Rainfall: 1000–2000 mm per year, uniform to winter max.

Distinctive features: Recognisable by its conical habit and yellow-green foliage. The opposite, usually toothed leaves and aromatic smell are also useful features.



Atherosperma moschatum 1. Seedling 2. Adult leaves and fruit 3. Male flower (S.E.M.) 4. Female flower (S.E.M.) 5. Stand under *Eucalyptus nitens*, Bendoc, Vic. 6. Fruit 7. Fruits commencing to dehisce 8. Intermediate leaves 9. Floral buds 10. Trees, Upper Denison River, Tas. 11. Bark 12. Adult leaf nervation

Sassafras Yellow Sassafras, Golden Deal

Doryphora sassafras Endl.

Sassafras is a tall tree attaining a height of 42 m and a stem diameter of 1.2 m. The stem is not prominently buttressed and the crown is typically quite small and compact. The branches are positioned almost at right angles to the stem and a conspicuous bulge is often present where limbs join the main stem.

It occurs as scattered trees or in small groups in coastal rainforest areas from near the Victorian and New South Wales border, to just inside Queensland near the border with New South Wales. In Queensland the species is found chiefly in the MacPherson Ranges and the Killarney and Tambourine districts but extends north to near Gympie. In New South Wales some westernmost localities are near Oberon, Mt Wilson, Barrington Tops and Mt Coricudgy, near Mudgee.

The species can grow on a wide range of sites from plateau-like situations to moderate slopes and gullies. At higher elevations the species typically grows on red clay loams derived from basalt such as at Mt Wilson and Robertson, New South Wales. At medium elevations soils have sharp changes in texture being derived from sedimentary and metamorphic rocks.

Sassafras typically occurs in cool temperate (microphyll fern forests) or warm temperate rainforests (simple notophyll vine forests). The species is often dominant but common associated species are coachwood (*Ceratopetalum apetalum*) and crabapple (*Schizomeria ovata*). Silver sycamore (*Cryptocarya glaucescens*), pink corkwood (*Quintinia sieberi*), lilly pilli (*Acmena smithii*), blackwood (*Acacia melanoxylon*) and small-leaved laurel (*Cryptocarya foveolata*) occur at higher altitudes.

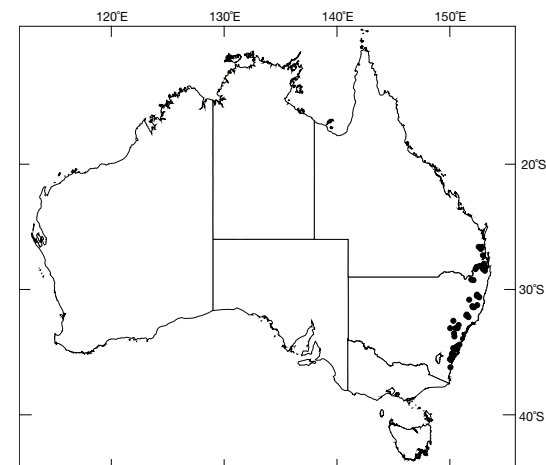
Related species: Sassafras belongs to the family Monimiaceae with *Atherosperma*, *Daphnandra*, *Hedycarya*, and *Wilkea*. It differs from *Atherosperma* and *Daphnandra* in the shape of the fruiting carpels and the larger flowers. In *Hedycarya* and *Wilkea* the fruit consists of several fleshy carpels seated on a disc. *Doryphora* is an endemic genus of two species, the other being *D. aromatica* (Bailey) L.S. Sm., which is endemic to north-eastern Queensland. *D. sassafras* var. *microphylla* is a small-leaved form which occurs on the north coast of New South Wales.

Publication: Endlicher, in *Iconogr. Gen. Pl.* t. 10 (1837). Type: 'Habitat in Nova Hollandia orientali' A. Cunninghamham.

Names: Botanical—*Doryphora*, from the Greek *doratus* (a spear), plus *phorus* (bearing, carrying), in reference to the bristle-like points of the anthers; *sassafras*, probably after the laurel of North America, *Sassafras* sp., which has a fragrance in the wood similar to *Doryphora sassafras*. Common—as above.

Bark: Grey or brownish grey, finely scaly, the scales small and pustular, under-bark fawn-brown, with a fragrant smell. Outer surface of live bark is dark pink-brown.

Leaves: Cotyledons—shortly petiolate, reniform to orbicular, about 0.9×0.7 cm. Seedling—opposite, short petioles 0.2–0.4 cm long, broad-lanceolate with serrate margins (10–14 teeth per leaf), 5–8 \times 2–3 cm, dark glossy green above and



paler beneath; stems slightly quadrangular; nervation reticulate with secondary veins at 40–60° to the midrib. Intermediate—opposite, petiolate, broadly lanceolate, up to 10 \times 5 cm, toothed. Adult—opposite, short petioles about 1 cm long, simple, elliptical or oblong-lanceolate, acuminate, narrowed at base, 7–10 \times 1.5–5 cm, coarsely toothed, glossy green above, dull green beneath, glabrous, fragrant when crushed; midrib distinct, lateral and net veins faintly visible on upper surface, raised and distinct on undersurface.

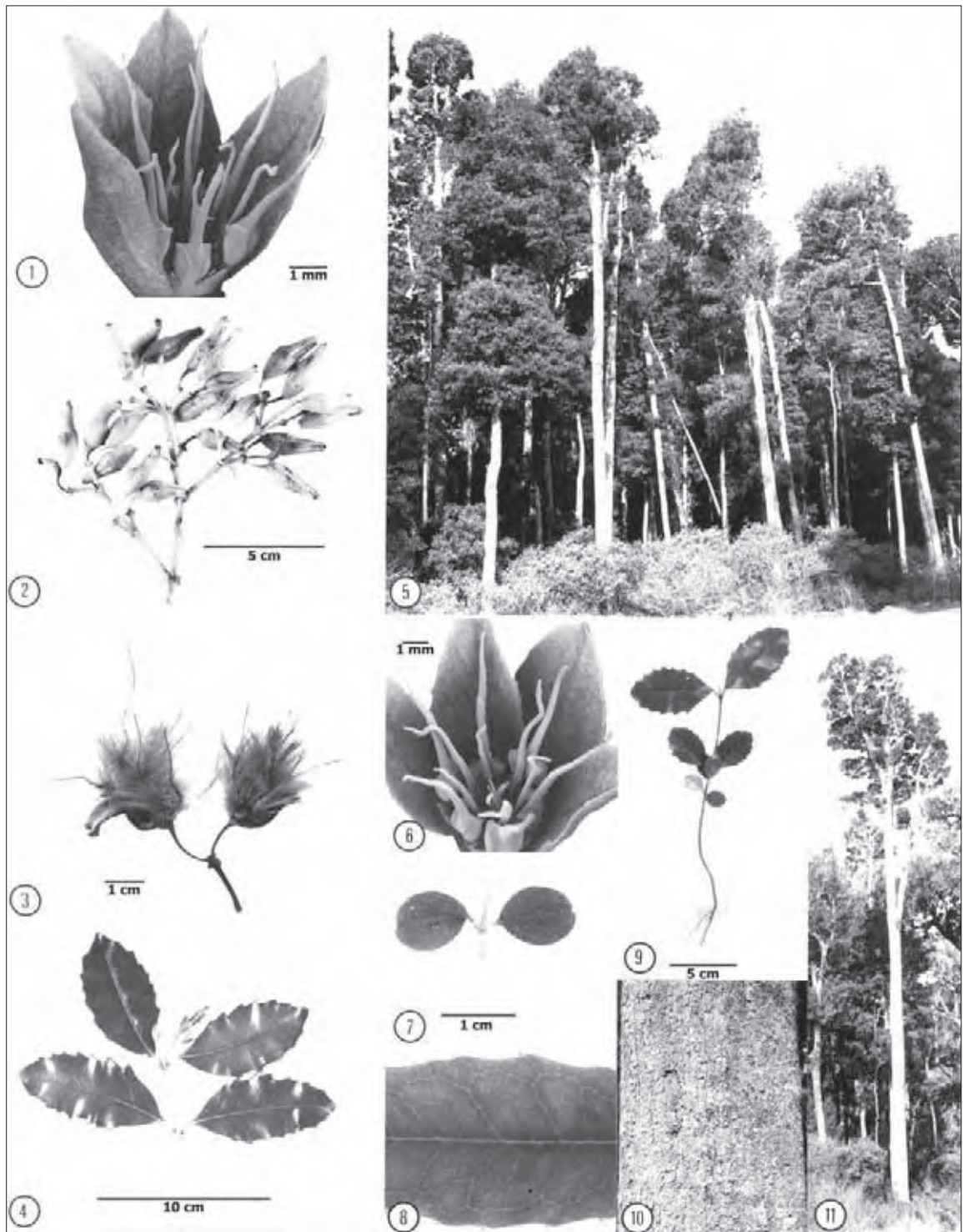
Inflorescences: Axillary, usually 1 or 2 inflorescences per leaf axil, usually 3 flowered, on a short peduncle 0.2–1 cm long, pedicels 0.3–0.6 cm long. Flowers white, silky-downy, 2–3 cm diameter. Perianth lobes 6, tapering to a fine point. Stamens 6, with anthers situated towards the base of the stamens and surmounted by long bristle-like points, with 6 alternating shorter staminodes. Carpels several, free, superior. Styles plumose. Flowers usually May–July.

Fruits: Lower part of the perianth is enlarged, becoming narrowly egg-shaped, 0.6–2 cm long with a long neck, splitting down one side when ripe to expose several dark brown, hairy carpels. Mature Mar.–Aug.

Wood: Sapwood pale and resistant to *Lyctus* attack; heartwood pale yellowish grey or brown, darkening on exposure usually with faint aromatic odour when freshly cut, fine-textured, usually straight-grained, not very fissile due to its tendency for brittleness, fairly soft and light, density 475–675 kg m⁻³. The wood is resistant to *Lyctus* attack but the durability is not high, particularly if exposed to the weather, and it is not termite resistant. The timber is easy to work and takes a good finish, and was used for small tool handles, interior linings and mouldings, cabinets, turnery and veneer.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest months: 25–30°C/3–10°C; Frost incidence: low to moderate at the higher altitudes; Rainfall: 1000–2000 mm per year, summer max.

Distinctive features: A rainforest tree with a small compact dense crown of glossy foliage. Bark, sapwood and leaves have a distinct aroma and the wood is pale yellow when freshly cut. White flowers with long bristle-like tips on top of the anthers. Fruits are narrowly egg-shaped and the carpels are very hairy.



Doryphora sassafras 1. Flower with one petal removed showing the awl-like structures above the anthers (S.E.M.) 2. Fruits 3. Fruits dehiscing and exposing hairy carpels 4. Adult leaves 5. Stand, Marengo State Forest, north-west of Dorrig, N.S.W. 6. Flower with one petal removed showing the style (S.E.M.) 7. Cotyledons 8. Nervation of adult leaf 9. Seedling 10. Bark 11. Tree with typical small crown, Marengo State Forest, N.S.W.

Moreton Bay Fig Figwood, Black Fig

Ficus macrophylla Desf. ex Pers.

Moreton Bay fig may be a tall tree attaining a height of 50 m and a stem diameter of 2.4 m or more. Crowns are typically branched heavily and consist of spreading masses of dark green foliage. The young leaves are characteristically rusty brown underneath. Old leaves, both senescent and dead, are yellow and contrast in colour with the glossy green living leaves. Stems are usually flanged and buttressed widely at their bases. In rainforests this species may begin life from seed lodged by birds in the bark or branch forks of another tree. The aerial roots develop in an anastomosing lattice and gradually enmesh and strangle the host.

This species occurs from the isolated Mt Dromedary population near Narooma, New South Wales, in the south, to near Brisbane in the north. The main southern stands of the species occur in the Illawarra district, New South Wales, such as around Kangaroo Valley, Minnamurra Falls and Kiama. In the northern part of the State it is found in most forests from Wingham to the Tweed River. In Queensland it is common in the southern forests and around Moreton Bay, and as far west as the Bunya Mountains.

This species grows in a wide range of sites from river valleys to hills of moderate slope. Soils are usually derived from alluvium at lower elevations while at higher elevations they are red clay loams derived from basalts.

Moreton Bay fig typically occurs in subtropical (complex notophyll vine forests) but also occurs in warm temperate rainforests (simple notophyll vine forests) and dry rainforests. Typical associates include white booyong (*Argyrodendron trifoliolatum*), *Flindersia* spp., giant stinging tree (*Dendrocnide excelsa*), brush kurrajong (*Brachychiton discolor*), red cedar (*Toona ciliata*), hoop pine (*Araucaria cunninghamii*), Moreton Bay green-leaved fig (*Ficus watkinsiana*) and white walnut (*Cryptocarya obovata*).

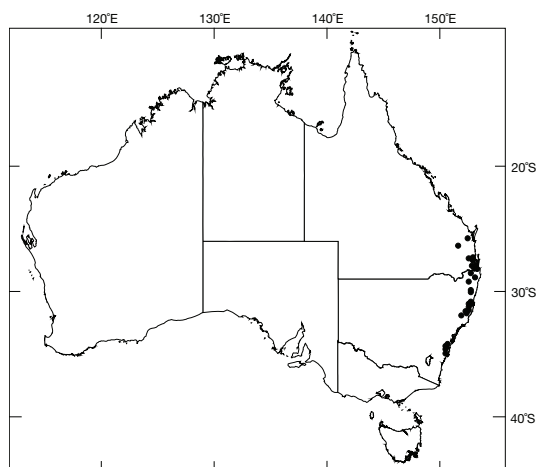
Related species: There are about 600 species of *Ficus* and all are found in the tropical and subtropical regions. There are 8 species that occur within the range of the distribution of *F. macrophylla*. These are *Ficus coronata*, *F. fraseri*, *F. rubiginosa*, *F. watkinsiana*, *F. obliqua*, *F. superba* var. *henneana*, *F. virens* var. *sublanceolata* and *F. platypoda*. *F. macrophylla* differs mainly in the larger stipules, larger leaves with the rusty brown undersides and the globular purple fruits covered in white dots.

Publication: *Synopsis Planarum* 2, 609 (1806). Type: 'Hab. in N. Hollandia.'

Names: Botanical—Latin *ficus* (a fig tree); *macrophylla*, Greek *macro* (large), plus *phyllon* (a leaf), alluding to the large leaves. Common—refers to the Moreton Bay area, Brisbane.

Bark: Dark, greyish brown, smooth, marked by numerous pustules, scattered small scales and horizontal narrow ridges. The cut blaze is pinkish white to mottled bright red, and the cut releases copious quantities of a milky viscous liquid typical of figs and species belonging to the family Moraceae.

Leaves: Seedling—has a rounded projection or auricle at the base of the blade on each side of the petiole, the younger



seedling leaves have toothed or lobed margins. Adult—alternate, petioles about 1–9 cm long, simple, oval-elliptical or broadly oblong, 10–23 × 6–12 cm, narrowed into a short blunt point at the apex, rounded at the base, leathery in texture, dark green and glossy above, underside usually brown when mature; nervation visible both surfaces but more conspicuous on the underside with numerous oblique parallel lateral veins looping at their ends to form an intramarginal vein 0.2–0.3 cm from the edge of the leaf; the new leaves, before they expand, are typically conical, being convolute in arrangement. Young buds are protected by large stipules, 10–17 cm long, which are also convolute, broad at the base, tapering into a long point, slightly downy on the outside and creamy-brown in colour. The twigs when broken exude a white milky liquid and the fallen stipules leave scar rings along the branchlets.

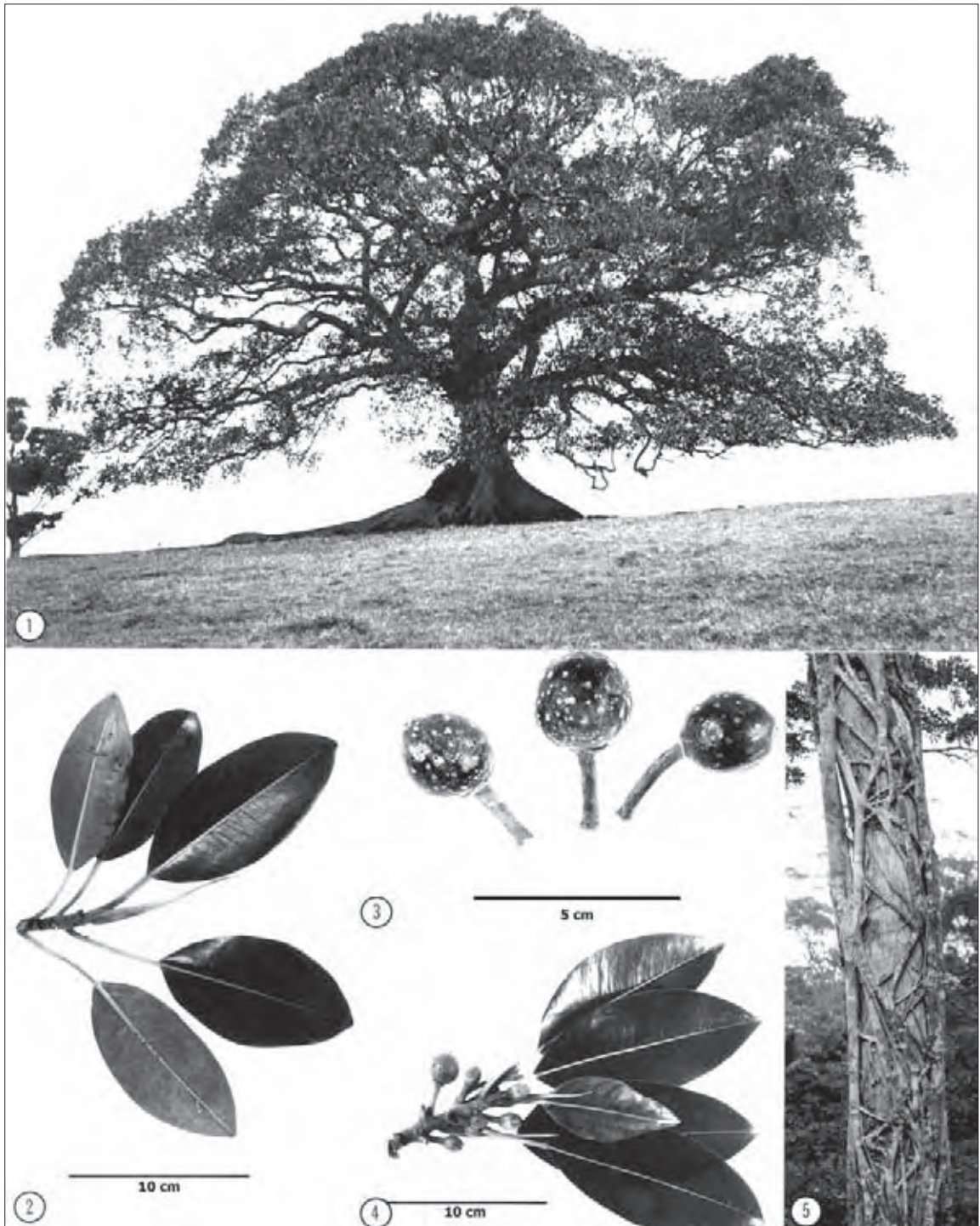
Inflorescences: Flowers unisexual enclosed within the hollow receptacle—a fig.

Fruits: Fleshy receptacle, globular, about 2.5 cm diameter, orange, turning purple, dotted white when ripe, borne on thick stalks 2–2.5 cm long, arising from the axils of the leaves. Fruits are edible, but rather dry.

Wood: Sapwood pale; heartwood white, open-grained, with a silken ray mottling and longitudinal soft tissue on the radial section and a brown satiny appearance of parenchyma (soft tissue) on the tangential section; density 235–470 kg m⁻³. The wood is easily worked and dresses with a mild sheen and attractive cedar-like (*Melia*) figure. The wood is not used to any degree in Australia but could be used for light panelling and light cabinetwork and packing cases. Aboriginal people used the durable fibres from the bark for making dilly bags and scoop nets for fishing.

Climate: Altitudinal range: near sea level to 900 m; Hottest/coldest months: 25–30°C/5–10°C; Frost incidence: mainly low but upland sites receive 1–2 per year; Rainfall: 1000–1700 mm per year, summer max.

Distinctive features: Purple fruits covered in white dots, large leaves with rusty brown undersides, very large stipules enclosing the buds, milky sap from broken twigs, and convolute new leaves. In the past Moreton Bay figs were commonly used as amenity plants.



Ficus macrophylla 1. Tree, Jamberoo, near Kiama, N.S.W. 2. Adult leaves and convoluted stipules 3. Mature fruits 4. Immature fruits and adult leaves 5. Anastomosing fig roots around a living tree

Lilly Pilly

Acmena smithii (Poir.) Merr. & L.M. Perry

Lilly pilly is usually a medium-sized to tall tree up to 20 m in height and 0.3 m in diameter, but is often reduced to a shrub in exposed coastal situations. On favourable sites trees can attain heights of up to 30 m with stem diameters of 0.6 m. The foliage is usually very dense and glossy, forming compact crowns.

Various forms of lilly pilly are distributed along the eastern coast of Australia from eastern Victoria to northern Queensland. The main occurrences in Victoria are Wilsons Promontory and along gullies and rivers in the far north-east. In New South Wales it occurs from the Eden area to Tweed Heads, and as far west as Wingello, Mt Kaputar, Newnes and Tenterfield. In Queensland, it extends from Coolangatta to the Windsor Tableland, and inland occurrences include the Bunya Mountains.

Lilly pilly grows along the banks of small streams and rivers on a wide range of soil types. Soils include stabilised coastal sands, those from sandstone parent materials as in the Sydney area, alluvial soils along small streams, basaltic red clay loams at higher altitudes and sandy loams derived from granite in Victoria.

In southern Australia this species grows in temperate rainforests while in northern Australia it is common in or on the edges of subtropical rainforests. There are numerous associates which include coachwood (*Ceratopetalum apetalum*), callicoma (*Callicoma serratifolia*), ironwood (*Backhousia myrtifolia*), sassafras (*Doryphora sassafras*), bangalow palm (*Archontophoenix cunninghamiana*), pinkwood (*Eucryphia moorei*), quandong ash (*Elaeocarpus reticulatus*), sweet pittosporum (*Pittosporum undulatum*) and kanuka box (*Tristania laurina*). Near the sea it is often stunted and associated with coast banksia (*Banksia integrifolia*).

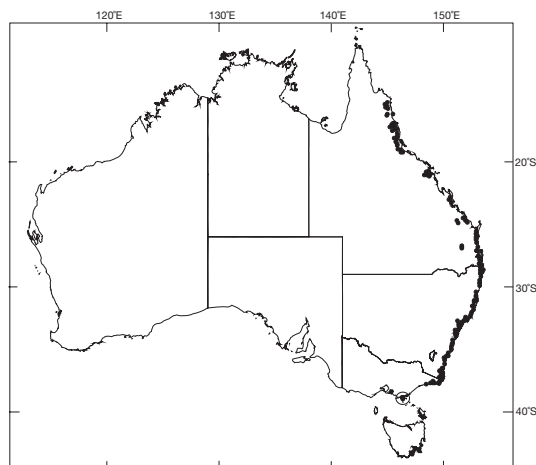
Related species: There are at least three poorly defined forms of *Acmena smithii*. The big-leaf form occurs from about Sydney south, while the small-leaf form (var. *minor*) occurs from about Newcastle to Brisbane (in the Upper Hunter, it occurs on serpentine), and the riparian form (having long narrow leaves) occurs from about Nowra to northern Queensland. Seven species of *Acmena* occur in Australia, of which six are endemic. *Acmena smithii* differs from the other species mainly in fruit colour and leaf shape.

Publication: *J. Arnold Arbor.* 19, 16 (1938). Type: Port Jackson, New South Wales, J. White.

Names: Botanical—*Acmena*, from the Greek *Acmenae* (the beautiful nymphs of Venus), perhaps in allusion to the flowers and fruits; *smithii*, honours J.E. Smith (1759–1828), an English botanist. Common—probably of Aboriginal origin although some early records note that children of Australian settlers called the species lilly pilly.

Bark: Red-brown and somewhat scaly, smooth on upper trunk and limbs.

Leaves: Cotyledons—thick, fleshy, closely appressed, cryptocotylar. Seedlings—opposite, sessile for about the first 4



pairs then shortly petiolate, petioles 0.1–0.3 cm long and purplish red in colour; leaves simple, entire, elliptical-ovate, 3–7 × 1–4 cm, margins slightly recurved, glabrous, dark green, discolorous; midrib sunken above, nervation not clearly visible, penniveined and intramarginal veins close to the margin and numerous oil dots visible; lignotuberous in young saplings in field situations in Victoria. Adult—opposite, petiolate to 0.3–0.9 cm long, simple, entire, broadly elliptical to ovate or broadly oblanceolate, 5–10 × 2–5 cm, with a long drawn out blunt tip, glabrous, dark green, glossy, discolorous; midrib raised beneath and somewhat sunken on the upper leaf surface, nervation visible above, finely penniveined, with numerous oil dots, intramarginal vein faint only slightly removed from the margin; adult leaves commonly have a curled and V-shaped appearance.

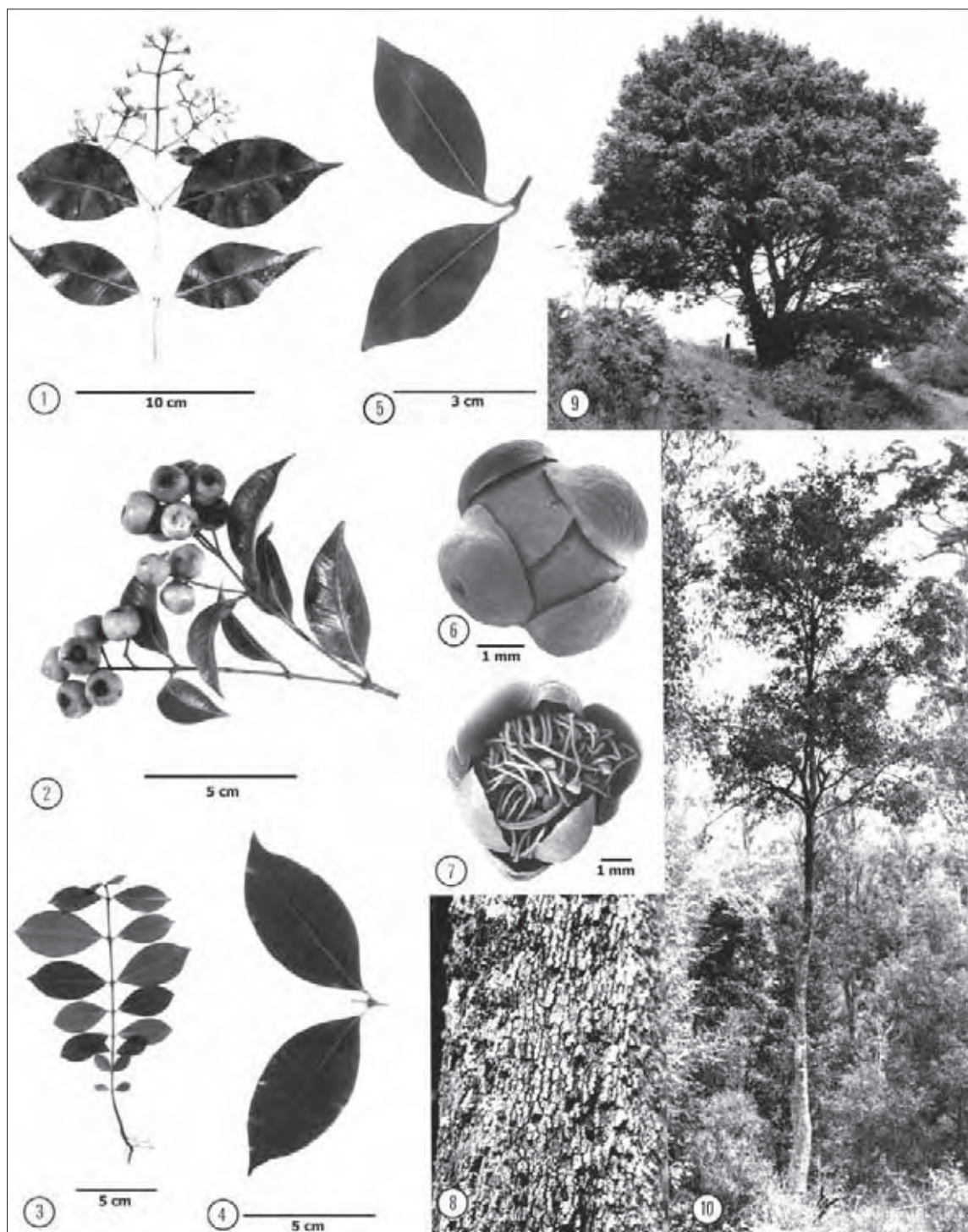
Inflorescences: Terminal panicles, flowers small and numerous, bracts minute and deciduous. Sepals 4, sometimes unequal, deciduous. Petals 4, cream, united to a small flat deciduous calyptra. Stamens numerous in more than one whorl, short. Ovary inferior, 2-locular with several ovules per loculus. Style simple. Flowers Nov.–Feb.

Fruits: Berries, 0.6–1.4 cm diameter, nearly globular, white to pale mauve or purplish, crowned by the circular rim of the calyx; seed surrounded by a succulent pulp. Mature late autumn and winter, edible, slightly acid.

Wood: Sapwood pale and susceptible to attack by *Lyctus* borer; heartwood white to light brown to pinkish brown-coloured, moderately strong, close-grained with no prominent figure, straight or wavy and interlocked, durable in the weather if in well-drained and ventilated positions but not durable in the ground, density 700 kg m⁻³. Timber can be used in general building construction and seasoned for use in internal fittings and frames and flooring.

Climate: Altitudinal range: near sea level to 1200 m; Hottest/coldest months: 26–32°C/5–15°C; Frost incidence: mainly low but moderate at upland sites in the south of its range; Rainfall: 700–2000 mm per year, summer max. 40, uniform.

Distinctive features: Purplish or white fruit in terminal clusters, glossy dark green leaves and scaly brown bark.



Acmena smithii 1. Immature fruit showing the nature of the inflorescence 2. Fruiting branch 3. Seedling 4. Adult leaves 5. Adult leaves of var. *minor* 6. Floral buds (S.E.M.) 7. Flower (S.E.M.) 8. Bark 9. Tree, Robertson, N.S.W. 10. Tree, Kioloa State Forest, near Batemans Bay, N.S.W.

Peppermint Western Australian Peppermint

Agonis flexuosa (Sprengel) Schauer

Peppermint occurs mainly as a small tree, growing occasionally up to 10–15 m tall and 0.5 m in diameter, but more commonly it is less than 10 m tall and often only a shrub of 2–3 m. The crown is rounded, fine-textured and rather dense, with pendulous branchlets and leaves.

This species occurs in coastal and subcoastal Western Australia from just north of Perth, southwards and then eastwards beyond Bremer Bay. A northern outlier is reported from near Cervantes, about 200 km north of Perth.

Peppermint is a common understorey tree in some of the wetter forests of south-western Western Australia, occurring in several forest associations. It may also be the dominant species in stands ranging in structure from open forest and woodlands to tall shrublands, or occur in mixtures with *Acacia*, *Melaleuca* or *Eucalyptus* species in open shrublands. Tall pure stands up to 15 m tall occur in sheltered sites in the Bremer Bay area.

Peppermint occurs most commonly on siliceous or calcareous sandy soils. On the sand dunes of the southern coast, it may form tall or open shrublands, increasing in height to low woodlands as sites become more sheltered. On swampy sites it is replaced by *Melaleuca* species or other species of *Agonis*. On sands over limestone in the tall woodlands of tuart (*E. gomphocephala*), peppermint characteristically forms a fairly dense understorey and, on sandy loams along the valley bottoms in jarrah–marri open forests, it may form virtually pure stands. It also occurs on sandy loams in the more open stands of karri (*E. diversicolor*) forest, particularly in valley sites where it is often with *Banksia littoralis* and Warren River cedar (*Agonis juniperina*).

Related species: The 11 species of *Agonis* are endemic to Western Australia. Only peppermint and Warren River cedar (*A. juniperina*) grow to tree size.

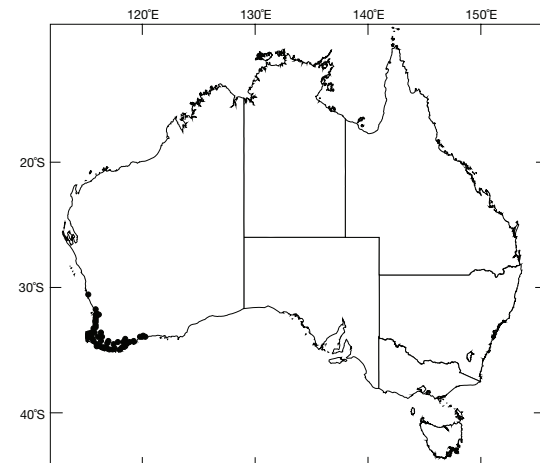
Publication: Schauer in *Pl. Preiss* 1, 116 (1844). Type: Not determined.

Names: Botanical—*Agonis*, from the Greek *agon* (a gathering or collection), probably referring to the tight, globular inflorescence; *flexuosa*, from the Latin *flexuosus* (zig-zag), changing direction at the nodes which is a feature of the plant. Common—alludes to the peppermint smell of crushed leaves.

Bark: Persistent on trunk and large branches, fibrous, brown.

Leaves: Cotyledons—shortly petiolate to 0.1 cm long, small, broad—ovate, 0.2–0.3 × 0.2–0.3 cm. Seedling—alternate, shortly petiolate for first few pairs then leaves become strongly decurrent. Adult—alternate, shortly petiolate, lanceolate to linear, acute, narrowed at both ends, 5–15 × 0.5–1.5 cm; a conspicuous intramarginal vein, with a second one sometimes present about one-third in from the margin; lateral veins widely spaced, about 15° to the midrib; oil glands present.

Inflorescences: Flowers in globular sessile heads in the axils of leaves; each head has about 12–14 individual flowers subtended by short, broad obtuse bracts. Calyx softly



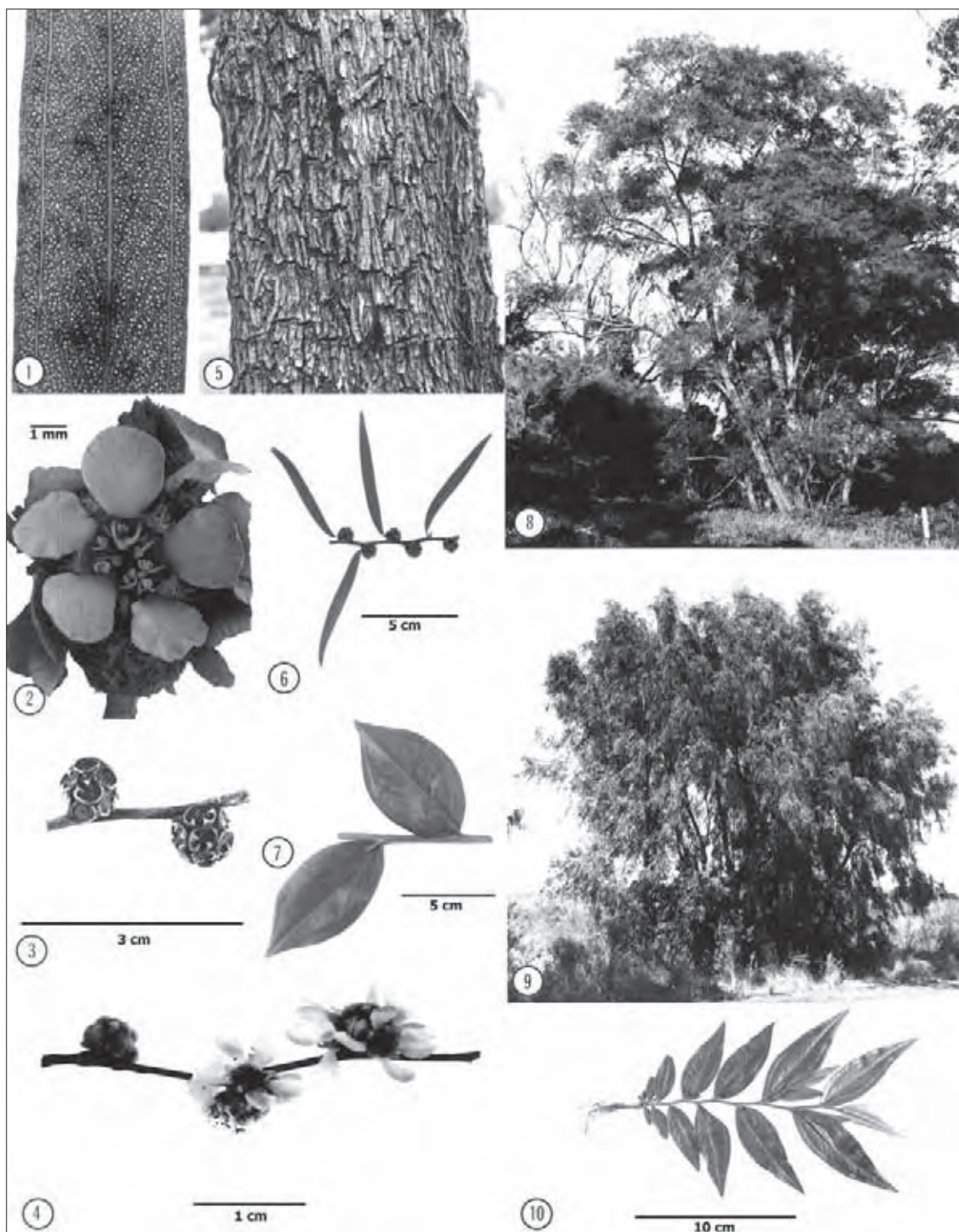
pubescent, hypanthium about 0.1 cm long, surrounded by 4–5 lobes, 0.05–0.07 cm long, acute, fringed. Petals 4 or 5, white, 0.4–0.5 × 0.2–0.3 cm, obovate to broadly spoon-shaped. Stamens usually 16–20, with 3–4 opposite each calyx lobe, none opposite the petals. Ovary immersed in the hypanthium, 3-celled with 6 ovules in each cell. Style simple. Flowers Oct.–Nov.

Fruits: In fused, globular clusters, 0.8–1 cm diameter; individual fruit 0.3–0.4 × 0.3 cm, conic, angular from compression, unripe fruit flat-topped with calyx lobes sometimes persistent, incurved. At seed shed, valves open wide, about level with narrow rim. Seeds narrow, teardrop shaped, 0.1 × 0.03 cm, black, pale brown membranous wing extending from broadest end, to 0.1 × 0.04 cm.

Wood: Sapwood pale; heartwood reddish brown, light brown to pinkish brown-coloured, density approximately 850–1000 kg m⁻³, moderately strong, fine-textured, of no known commercial value.

Climate: Altitudinal range: near sea level to 200 m (on the Naturaliste–Leeuwin ridge); Hottest/coldest months: 26–30°C/7–9°C; Frost incidence: negligible to low; Rainfall: 800–1200 mm per year, winter max.

Distinctive features: A small, pendulous, rough-barked tree, leaves narrow, pendulous with a strong fragrance of peppermint; flowers with 4 or 5 white petals; fruits woody, fused to form globular clusters. Commonly cultivated as an amenity tree in parks, gardens and as a street tree in southern Australia. There are numerous cultivars of peppermint that have been registered by the nursery trade.



Agonis flexuosa 1. Nervation of adult leaf 2. Flower (S.E.M.) 3. Fruit 4. Flowering branch 5. Bark 6. Fruiting branch 7. Intermediate leaves 8. Tree, Albany, W.A. 9. Stand, Albany, W.A. 10. Seedling

Eucalypts

Eucalyptus L'Hérit. (1788) [*Eudesmia* R. Br. (1814); *Symphyomyrtus* Schauer (1844)]

Angophora Cav. (1797)

Corymbia K.D. Hill & L.A.S. Johnson (1995)

Distribution, Form and Use

Eucalypts dominate the natural forests and woodlands of the better-watered regions of Australia. Eucalypt mallee scrub covers vast areas of the drier country, particularly in the grain-cropping regions in the south. A few species are indigenous to islands north of Australia but only two (*E. urophylla* and *E. deglupta*) are endemic outside Australia. Industrial plantations (predominantly Tasmanian blue gum, *E. globulus*) are becoming more common over large areas of temperate Australia.

Areas where eucalypts are notably absent are the tropical and subtropical rainforests of the eastern Australian mainland and the temperate rainforests of Victoria and Tasmania. They are also largely absent from the extensive arid zones of inland, mid-southern (Nullarbor) and north-western Australia, although a few species are abundant along the watercourses in these regions. Small niches where eucalypts do not grow are the summits of the alpine country of south-eastern Australia, where no trees grow at all due to the high winds and intense cold, although snow gums, often in much distorted form, approach to an altitude of about 2000 m.

There are about 900 eucalypt taxa. Many are site-sensitive, having particular edaphic preferences, like black-soil plains, siliceous or gypseous dunes, sandy soils with lime content, sandstone-derived soils, and so on, while other species are distributed over wide geographic and environmental gradients and show a relatively wide tolerance to soil type. Generally, however, the species are divided into a northern, summer rainfall group and a southern, winter rainfall group although a few species have adapted, probably in different physiological forms, to both low and high latitude regions, particularly on the

eastern seaboard. A large, third group with a high degree of endemism occupies the south-west of Western Australia and has probably been in genetic isolation for a long period due to the barrier of the Nullarbor Plain which is unfavourable for tree growth.

As would be expected in a genus so widespread and comprising hundreds of species, a great range in form is exhibited by members growing under different environmental conditions.

Mountain ash (*E. regnans*) of Victoria and Tasmania reaches heights of over 90 m, making it the tallest species in Australia and the tallest hardwood in the world. Other notable forest trees reaching great size are the Western Australian species karri (*E. diversicolor*) and the south-eastern Australian and Tasmanian species messmate stringybark (*E. obliqua*), southern blue gum (*E. globulus*), manna gum (*E. viminalis*) and alpine ash (*E. delegatensis*). Tall tree species in the summer rainfall zone, which characterise the moist forests of New South Wales and Queensland, include Sydney blue gum (*E. saligna*), flooded gum (*E. grandis*), blackbutt (*E. pilularis*) and tallowwood (*E. microcorys*). All these species dominate tall open forests on the deeper, commonly loamy soils of the higher rainfall areas. Such trees are often over 45 m in height, long-boled and may attain 6 m in girth at breast height. One mountain ash felled for conversion to paper pulp measured 20 m around the butt. Great volumes of timber are contained in mature trees of this kind and this same tree yielded 190 m³ (or 200 tonnes) in log timber.

A considerable number of valuable eucalypts do not attain the giant dimensions of mountain ash and other very tall species and frequently are no more than 35 m in height. Examples of trees of this type are jarrah (*E. marginata*) of Western

Australia, brown stringybark (*E. baxteri*) from occurrences in Victoria and white stringybark (*E. globoidea*) from Victoria and New South Wales. Spotted gum (*E. maculata*) and red bloodwood (*E. gummifera*) are further examples from the east coast.

Outside the forested country many important eucalypts dominate woodlands over much of northern Australia, and in areas of southern Australia receiving less than 750 mm of rain annually. These widely spaced trees are often less than 25 m high, with a short thick trunk and with heavy limbs forming a broad, spreading crown. Sometimes the same species may occur in forests as well as woodland and it then assumes the form characteristic of the formation in which it grows. The red gum, ironbark and box groups of eucalypts are well represented in these open stands of northern and eastern Australia. Wandoo (*E. wandoo*) and tuart (*E. gomphocephala*) are typical woodland species of the south-western region. Salmon gum (*E. salmonophloia*) is a remarkable Western Australian woodland species, which grows to heights of 30 m in areas with rainfall as low as 250 mm.

Because of their abundance and variety, the eucalypt forests and woodlands provide an enormous resource of hardwood timber varying in such characteristics as colour, weight, hardness, toughness, strength, elasticity, durability and fissibility. Because of this diversity of properties, eucalypt timbers have innumerable uses. Many are pre-eminent for heavy structural purposes such as bridge building and harbour works. Others are excellent for scantling and general building timber, posts and poles, fencing, railway sleepers, cabinet making, hardboard, plywood, paper pulp and fuel. More recently eucalypts have supplied the basic material for the woodchip industry.

Apart from the major uses as timber and its derivatives, some trees yield valuable essential oils, which are extracted by distillation of the foliage. These oils are widely used in pharmacy, perfume manufacture and industry. Tannins and rutins are extracted in commercial quantities from the wood and bark of some species.

Of lesser commercial importance but occupying large tracts of infertile regions between the woodlands and the desert country are the mallees, which exhibit a characteristic multi-stemmed, dwarf form. Several to many stems, often up to no more than 6 m in height, arise from a lignotuber (thickened woody rootstock), which is embedded in the upper layer of the soil. The lignotuber has great survival potential in times of drought and fire, as new stems may sprout repeatedly from the buds concealed in the woody mass. The lignotubers or 'mallee roots' are used as fuel in drier areas, particularly in South Australia and Western Australia.

A small number of eucalypts particularly from Western Australia are of shrubby form and are of interest, for their decorative appearance, flower colour and drought-resistant properties.

Botanical history and taxonomy

The genus *Eucalyptus* was named in 1788 by Charles-Louis L'Héritier de Brutelle, a citizen of France working in London at the time. The name of the genus was coined when he published *E. obliqua*. The new genus was based on a specimen collected in 1777 on Bruny Island off the south coast of Tasmania by a botanist on Captain Cook's third voyage. Hundreds of species and infraspecific species have since been described and about 900 are currently recognised. Placing all the eucalypts into a systematic order is now a vastly more intricate procedure than the first attempt (Willdenow 1799) when only 12 species were known and were put into two categories depending on the shape of the operculum.

The first significant and comprehensive classification of the eucalypts was by G. Bentham (1867), who treated 135 species. In the following 60 years, the number of species recognised was increased by F. von Mueller (1825–1896) and particularly J.H. Maiden (1859–1925). Among the numerous major writings of Mueller was *Eucalyptographia* (1879–84), which treated and illustrated 150 species and referred to about 30 others. Maiden's monumental eight-volume *Critical Revision of the Genus Eucalyptus* (1903–33) was a comprehensive examination of the

genus known at that period. When W.F. Blakely published his *Key to the Eucalypts* (1934), which was a synthesis of Maiden's and his own work, over 500 species were documented and grouped according to Bentham's 1867 classification.

E.C. Andrews (1913) foreshadowed the recognition of infrageneric groups in *Eucalyptus*. This concept was taken up many years later by L.D. Pryor and L.A.S. Johnson who published *A Classification of the Eucalypts* (1971), an informal classification for the whole genus. G.M. Chippendale (1988) also treated over 500 species, however, this treatment was soon to become obsolete due to the increase in the number of taxa recognised during the years 1980–2000. This was due mainly to the work of L.A.S. Johnson and M.I.H. Brooker, who with colleagues published over 400 taxa between them.

A major formal change at genus level was published in 1995 when Pryor and Johnson's informal subgenus *Corymbia* (bloodwoods) was raised to generic rank by K.D. Hill and L.A.S. Johnson (1995). This newly erected genus included Pryor and Johnson's informal subgenus *Blakella* (ghost gums). Later, Brooker (2000) maintained *Corymbia* as a subgenus of *Eucalyptus* (for the bloodwoods), formally erected the subgenus *Blakella* (the ghost gums), and reduced *Angophora* to a subgenus of *Eucalyptus*. To date, the recognition of *Corymbia* at genus level and the rejection of *Angophora* at subgenus level, appears to have gained acceptance, at least in the scientific literature. Apart from morphological differences, breeding barriers are operative among the currently recognised subgenera (excluding the monotypic subgenus *Idiogenes* represented by *E. cloeziana*). As noted by Pryor and Johnson (1971) the subgenera are effectively genetically isolated groups, which has important practical implications for disciplines such as tree breeding, ecology, ecophysiology and genetics. Recent phylogenetic studies have clarified relationships among some eucalypt groups (e.g. Steane *et al.* 2002) but similar, more detailed studies are required before a consensus on higher-level classification in this large group is likely to be achieved.

Brooker's *Systema Eucalyptorum* (2000) is a formal synthesis of some of the infrageneric nomenclature of Bentham (1867), Blakely (1934), Pryor and Johnson (1971) and Chippendale (1988), but expanded to recognise seven polytypic and six monotypic subgenera and numerous new infrageneric groups. His assessment of interspecies relationships (discussed extensively in this edition under the 'Related species' section) is likely to be the modern benchmark for future lower-level phylogenetic studies.

Classifications can be pictured schematically as a pyramid with the genus at the top. Immediately below are subgenera, then sections which are themselves divided into series then subseries comprising groups of related species. Of the 900 or so species and subspecies which occupy the base of the pyramid, there are many which are relatively easy to identify because of their distinct and constant characters. Other species, however, do not lend themselves to such easy recognition. This is usually due to their more recent evolution, that is they show minimal divergence from their congeners. Such species share many characters with closely related species and may still be exchanging genes with them via the intermediate populations. Identification can be complicated by hybrids formed by direct crossing and which show greater adaptability to survive in disturbed habitats than the parent species.

The integrity of subgenera, sections and series is strong. It is less so for subseries and species. Therefore, it will be an advantage to understand the taxonomic features, which, in association, define many of these groups. The largest groups themselves are discussed separately throughout the text.

Morphology and Identification

Identification of eucalypts is not a simple task when insufficient characters are available for inspection. A positive identification can generally result only from the careful consideration of a number of features possessed by an individual. Important are the general size and form of the trees, the nature of the bark on the trunk and branches, characters of the embryo (cotyle-

Key to groups*

1. Ovular structures in 2 vertical rows over whole placenta monocalypts (*Eucalyptus*)
- 1: Ovules in >2 vertical rows or in 2 rows with >2 at top of placenta 2
 2. Seeds needle-shaped (acicular) *E. curtisii* (*Acerosa*)
 - 2: Seeds otherwise (e.g. flat, pyramidal, cuboid, spherical or winged at one end) 3
 3. Cotyledons flat in the embryo ghost gums (*Blakella*)
 - 3: Cotyledons folded slightly or wholly in the embryo 4
 - 4: Flower bud with an outer floral whorl of separate sepals, not fused into an operculum 5
 - 5: Distinct sepals present on buds 6
 6. White petals present. No operculum angophoras (*Angophora*)
 - 6: Inner floral whorl an operculum, not petals 7
 7. Sepals finally shed from buds, inner operculum present *E. steedmanii*, *E. mimica* (*Symphyomyrtus*)
 7. Sepals (teeth) persistent to the fruits eudesmids (*Eudesmia*)
 - 5: Sepals minute, shed early in bud development 8
 8. Inflorescences compound, branched, axillary *E. cloeziana* (*Idiogenes*)
 - 8: Inflorescences simple 9
 9. Seeds flattish, honeycombed (alveolate) *E. microcorys* (*Alveolata*)
 9. Seeds cuboid, smooth *E. tenuipes* (*Cuboidea*)
- 4: Flower bud with an operculum (single or double), no separate sepals 10
 10. Anthers butterfly-shaped (papilionate) *E. guilfoylei* (*Cruciformes*)
 - 10: Anthers otherwise, oblong, wedge-shaped (cuneate), kidney-shaped (reniform), or more or less spherical (globose) 11
 - 11: Inflorescences in leaf axils 12
 - 12: Inflorescences simple, in single clusters, not branched 13
 13. Anthers with confluent dehiscence slits monocalypts, some snow gums (*Eucalyptus*)
 13. Anthers with separate slits or pores symphyomyrts (*Symphyomyrtus*)
 - 12: Inflorescences compound, in branchless leafless clusters 14
 14. Outer operculum held till flowering bloodwoods (*Corymbia*)
 14. Outer operculum shed early in bud development symphyomyrts (*Symphyomyrtus*)
 - 11: Inflorescences terminal on branchlets, compound 15
 15. Seeds with terminal hilum *E. rubiginosa* (*Primitiva*)
 - 15: Seeds with ventral hilum 16
 16. Inflorescences terminating in a floral bud *E. raveretiana* group (*Minutifructus*)
 - 16: Inflorescences terminating in a vegetative bud, usually shed before flowering 17
 17. Anthers adnate, rigid at top of filament boxes, ironbarks (*Symphyomyrtus*)
 - 17: Anthers versatile, pivoting at top of filament 18
 18. Outer floral whorl an operculum, 2 opercula present bloodwoods (*Corymbia*)
 - 18: Outer floral whorl lacking, single operculum present eudesmids (*Eudesmia*)

*Many of the key characters will seem inaccessible to the casual user, but this emphasises that natural relationships within the genus are seldom based on superficial features. External characters like bark, subject to age and weathering, are poor indicators of affinities. For example, the ironbarks belong to three different groups recognised by number of opercula and stamen characters. The sepals seen on the buds of *E. steedmanii* and *E. mimica* (and sometimes on cultivated specimens of *E. kruseana*) are recognised as curious atavisms, lost in obviously related species, or relatively recent developments of no observable adaptive advantage. The weight of other morphological evidence would in no way have these three species placed in subgenus *Eudesmia*.

dons), the seedling, juvenile, intermediate and adult leaves including venation and oil gland patterns, inflorescence type, and size, shape and structure of buds and fruits, and seed morphology. Where naturally occurring plants are concerned, the geographical location and habitat can be of great assistance in their identification as many species are strictly limited in their distribution.

The traditional method for the identification of plants has been by the use of dichotomous keys. The disadvantage of these keys is that the user is required to rigidly follow pre-ordered steps by having to make a decision about every character as it appears in the key. Not all characters used in the key may be available, e.g. the specimen may have leaves and fruit but lack buds. The bud character may appear early in the key and the user cannot proceed. A recent innovation in plant identification has been the development of interactive computer keys in which the user simply assesses only the characters present on the specimen, and in any order. Brooker *et al.* (2001) is an interactive key to 690 eucalypts from southern Australia that also presents images and nomenclatural, morphological and systematic information for each taxon.

Some key aspects of the morphology of eucalypts are outlined in the following:

Germination: The quickening embryo consists of a root, a root collar, a hypocotyl (stem below the cotyledons), a pair of cotyledons, an epicotyl (stem above the cotyledons) and an apical meristem. Germination is epigeal; this means that the hypocotyl elongates as the cotyledons unfold,

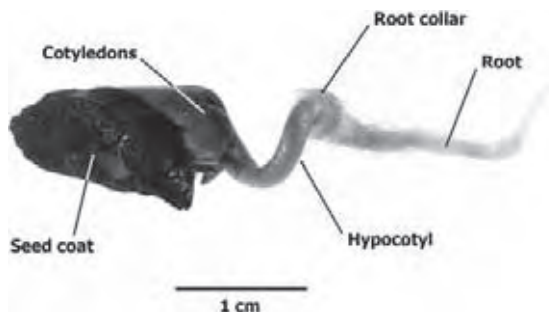


Figure 15. A germinating seed of *E. calophylla* showing the root, root collar, hypocotyl, cotyledons and partially shed seedcoat.

thereby raising above the ground the imperfectly shed seedcoat which finally drops. The epicotyl then begins to elongate raising the developing meristem above the cotyledons (Fig. 15).

Cotyledons: The first pair of leaves, namely the seed leaves or cotyledons, are different in shape from the succeeding leaves. The cotyledons may be reniform (Fig. 16a), bilobed (Fig. 16b) or bisected (Fig. 16c).

Phyllotaxis: The initial leaf arrangement is decussate in all but a few species. This means that the leaves develop in opposite pairs beginning with the seed leaves (cotyledons), such that the axis joining any pair is at right angles to the axis of the pair immediately above or below (Fig. 17a). In some narrow-leaved species the phyllotaxis soon changes to spiral (Fig. 17b) but reverts to decussate later. A very few species maintain a spiral phyllotaxis on a three-sided axis in maturity (Carr and Carr 1980).

Lignotubers: There are leaf-shoot buds in the axils of all leaves including the cotyledons. In

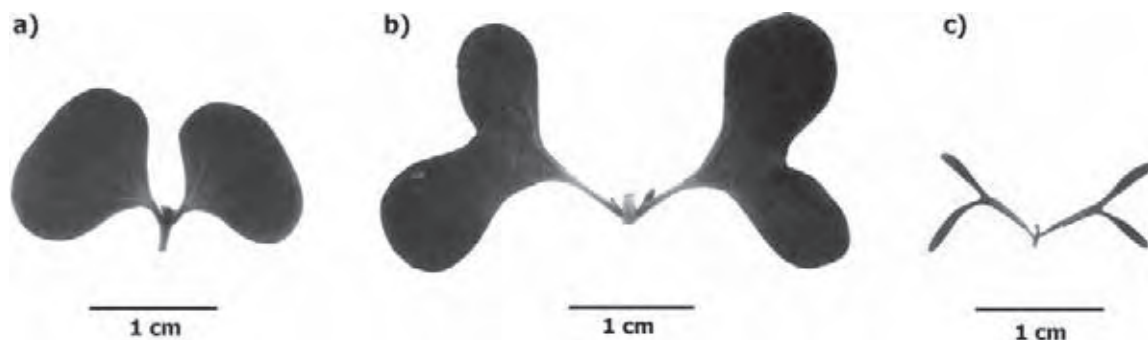


Figure 16. Forms of cotyledons: (a) reniform (*E. megacarpa*); (b) bilobed (*E. globulus*); (c) bisected (*E. transcontinentalis*).

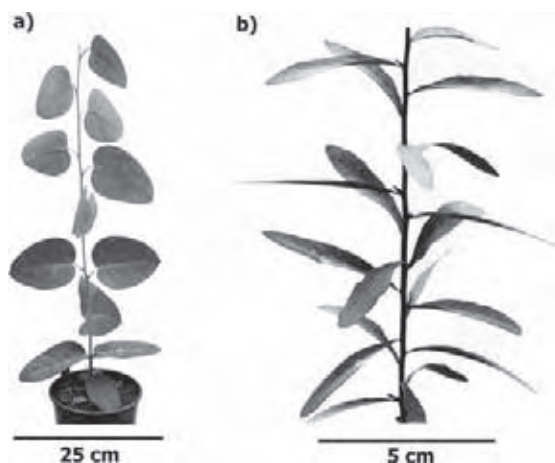


Figure 17. Phyllotaxis: (a) A seedling of *E. delegatensis* showing decussate phyllotaxis (note also the early change from horizontal to vertical disposition of the leaves, a feature of the ash group of eucalypts).

(b) A section of a seedling of *E. nicholii* showing spiral phyllotaxis.

some species axillary buds, particularly those of the cotyledonary axils and subsequent lower leaf axils develop into woody tubers. In the early stages of development (Fig. 18a) they appear as lumps decussately arranged (because of their original location on the stem). Later they enlarge and join to form a single irregular woody mass—the lignotuber. The lignotuber may become massive in the adult plant and is itself an organ with dormant buds which may become stimulated to produce shoots if the rest of the plant is destroyed by fire or cut down. The lignotuber is therefore vital in the regeneration of some species. Other species are not capable of producing lignotubers (Fig. 18b) and can only regenerate after fire by seed.

Heterophylly: Eucalypts are heterophyllous. This means that they produce different types of leaf at different stages of maturity of the plant. In eucalypts four stages are recognised: seedling, juvenile, intermediate and adult (see Blake 1953). Although the sequence for one species, namely eurabbie (*E. bicostata*), is shown (Fig. 19) it is not possible to summarise the sequence for the whole genus here because the leaf shapes and number of nodes per stage vary between species groups. This information is given and illustrated where relevant in the individual species treatments.

Leafy shoot: Over a growing year eucalypt shoots produce about 5 to 10 pairs of leaves although the capacity to produce leaf pairs is probably indefinite and leaf production is likely to be arrested only by the ending of the annual growth period. There is usually an increasing gradient in leaf size from leaf pair 1 to about leaf pair 5 then a reduction in size in subsequent pairs. Therefore, when considering leaf characters, care should be taken that a mature, adult leaf is being examined. While the leaves form in opposite pairs, unequal elongation of the axis between the leaf bases results in the leaves of a pair being apparently alternate in the mature plant of most species. In some species true adult leaves are rarely formed and the tree is reproductively mature when the leaves are in a pre-adult phase (e.g. mottlecrah, *E. macrocarpa*). Leaf thickness is variable and difficult to assess by the fingers, and where relevant, the terms ‘thin’ (e.g. white mahogany, *E. acmenoides*), ‘firm’ (e.g. southern blue gum, *E. globulus*) and ‘thick’ (e.g. brown stringybark, *E. baxteri*) are used.

Leaf venation and oil glands: There are no comprehensive studies of the anatomy of leaves in *Eucalyptus*. In addition to their size, shape and colour, description of the internal features of the leaves is usually confined to the angle of the side veins to the midrib and the density of the oil

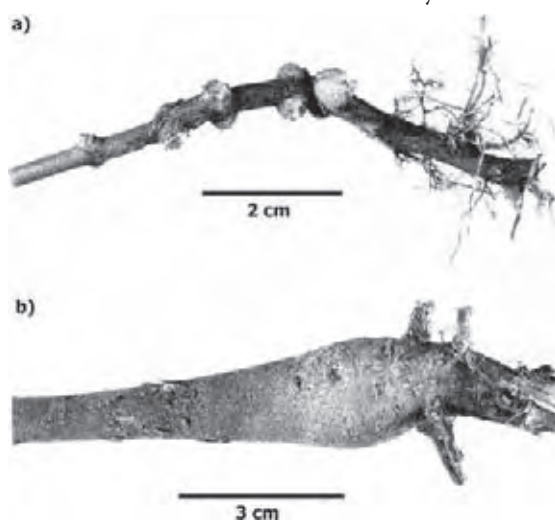


Figure 18. Lignotubers: (a) An early stage in the development of the lignotuber of *E. pauciflora* subsp. *niphophila*. (b) The swollen but non-lignotuberous base of *E. pilularis*.

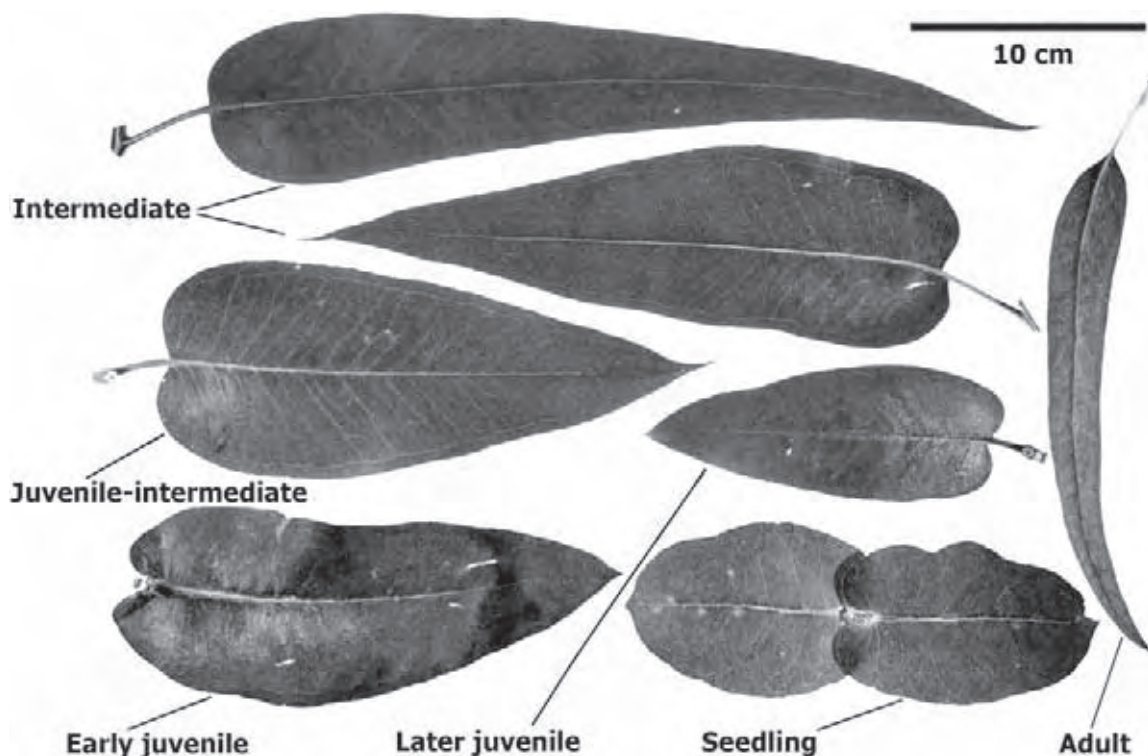


Figure 19. Heterophylly in *E. bicostata* showing the progression from seedling through juvenile and intermediate to the adult leaf stage.

glands. Both features become somewhat obscured in dried specimens.

The extreme difference between species can be seen in the wide-angled, pinnate side venation in the bloodwoods and the parallel venation in snow gums and some peppermints. In most species the side veins end at a looping intramarginal vein just inside the leaf margin. In desert bloodwoods, e.g. *E. terminalis*, and the ironbark, *E. exilipes*, the side veins run to the margin of the leaf. The side (secondary) veins may be linked by veinlets (tertiary veins) resulting in a moderate (e.g. *E. macrorhyncha*), or dense reticulum (e.g. *E. ovata* or *E. howittiana*). In some species side veins are almost absent (e.g. *E. approximans*).

Oil glands in the leaves can be absent as in desert bloodwoods, or so numerous that they obscure the venation as seen in sand mallet, *E. eremophila*. By holding a fresh leaf to the light, the glands can be seen if present. In most species they appear as round or slightly irregular struc-

tures within the leaf tissue. The glands may be isolated in the areoles (island glands) as in the peppermints, or appear to be 'attached' to or touching the veinlets or a mixture of both, as in Tasmanian blue gum, *E. globulus*. In some mal-lees, the glands can appear to be completely attached to minor but distinct veinlets (intersectional) as in salt gum, *E. salicola*. These last-named 'veinlets' may not be actual vascular tissue and their structure and function are unknown.

Baker and Smith (1920) made anatomical studies of some eucalypt leaves. The transverse sections show that the glands are spherical and usually in two rows, one just beneath the upper epidermis and the other just above the lower epidermis.

Pith: In the pith of the shoots of many species there are glands. These are a useful diagnostic feature seen by stripping away from the main axis a petiole or side shoot to expose the pith (e.g. gimlet, *E. salubris*, Fig. 20).

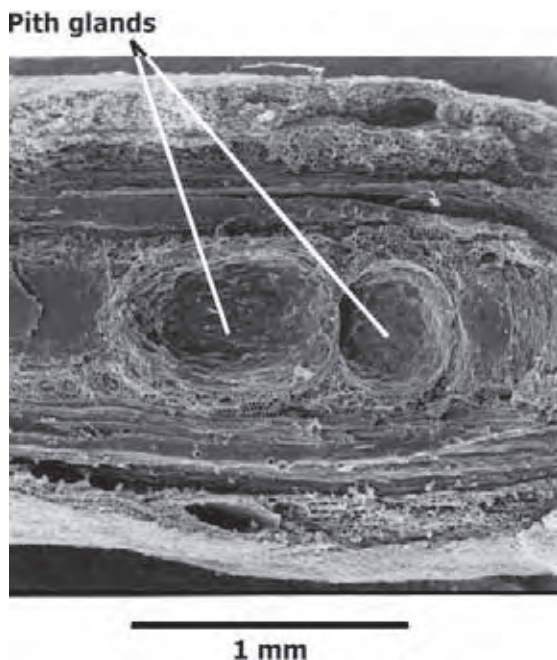


Figure 20. Pith glands in *E. salubris* [$\times 35$].

Bark: The bark of trees consists of a thin external cylinder of moist tissue, the function of which is to transport plant foods. This layer of tissue dies annually. It dries out and becomes the conspicuous outer dead bark, which is annually deciduous in gum-barked (smooth-barked) eucalypts exposing new inner bark (the new layer of functional tissue), and which is often highly coloured. In this condition it may characterise a species or a group of species such as the grey gums (e.g. *E. punctata*). In rough-barked species the outer dead bark is retained and accumulates year by year. As the tree diameter increases, the dead bark mass tears longitudinally forming characteristic patterns depending on the length and nature of the fibres. As a result the outer non-decorticated bark has many forms, which are recognised as stringybark (e.g. *E. globoidea*), box-bark (e.g. *E. albens*), ironbark (*E. paniculata*), etc. In some species the rough bark is retained on only the lower 1/3–2/3 of the trunk. These are commonly called ‘half-barked’ species. When the basal stocking of rough bark is naturally dark in colour (*E. lesouefii*) or frequently burnt (e.g. *E. pilularis*), they are loosely called ‘blackbutts’. In some species the annually decor-



Figure 21. Crown of *E. smithii* showing hanging ribbons of decorticated bark.

ating bark sheds in long ribbons that are imperfectly detached and remain hanging in the crown and about the trunk (Fig. 21). These are the ‘ribbon gums’ (e.g. *E. viminalis*, *E. smithii*).

Inflorescences: The flower buds form singly or in 3s, 7s, 9s, 11s etc. flowered clusters borne on a common peduncle (Fig. 22). The peduncles may arise singly (rarely in pairs, e.g. *E. fastigata*) in the leaf axils (Fig. 23a) or they may be arranged decussately on an axillary rachis (Fig. 23b) or they may be in a branched, terminal panicle (Fig. 23c). We use the term ‘panicle’ for most relevant species, e.g. bloodwoods and boxes because of common usage, although these inflorescences are leafless clusters of unit inflorescences terminating in a deciduous vegetative bud. The flower-bud clusters develop initially within protective bracts that shed as the buds swell. Peduncle length is usually given for the bud stage of the inflorescence. At the fruiting stage the peduncle may be longer, stouter, or flatter or more or less angular in section.

Flower buds: A flower bud consists of a stalked or sessile hypanthium (an enlarged receptacle, invaginated in eucalypts), which is surmounted by one or two opercula (derived from the fusion

of the petals or the sepals). These protect the male and female parts of the flower during their maturation. The orientation of stamens in bud may be readily seen by making a vertical section. The filaments may be erect, flexuose or inflexed (Fig. 24). At anthesis, the operculum or opercula

are shed and the stamens spread. In eucalypts the anthers are either versatile, that is, they pivot freely at the top of the tapering filament (Fig. 25a), or adnate, that is, they are seated rigidly at the summit of a non-tapering filament (Fig. 25b). The ovary chambers, which contain the placen-

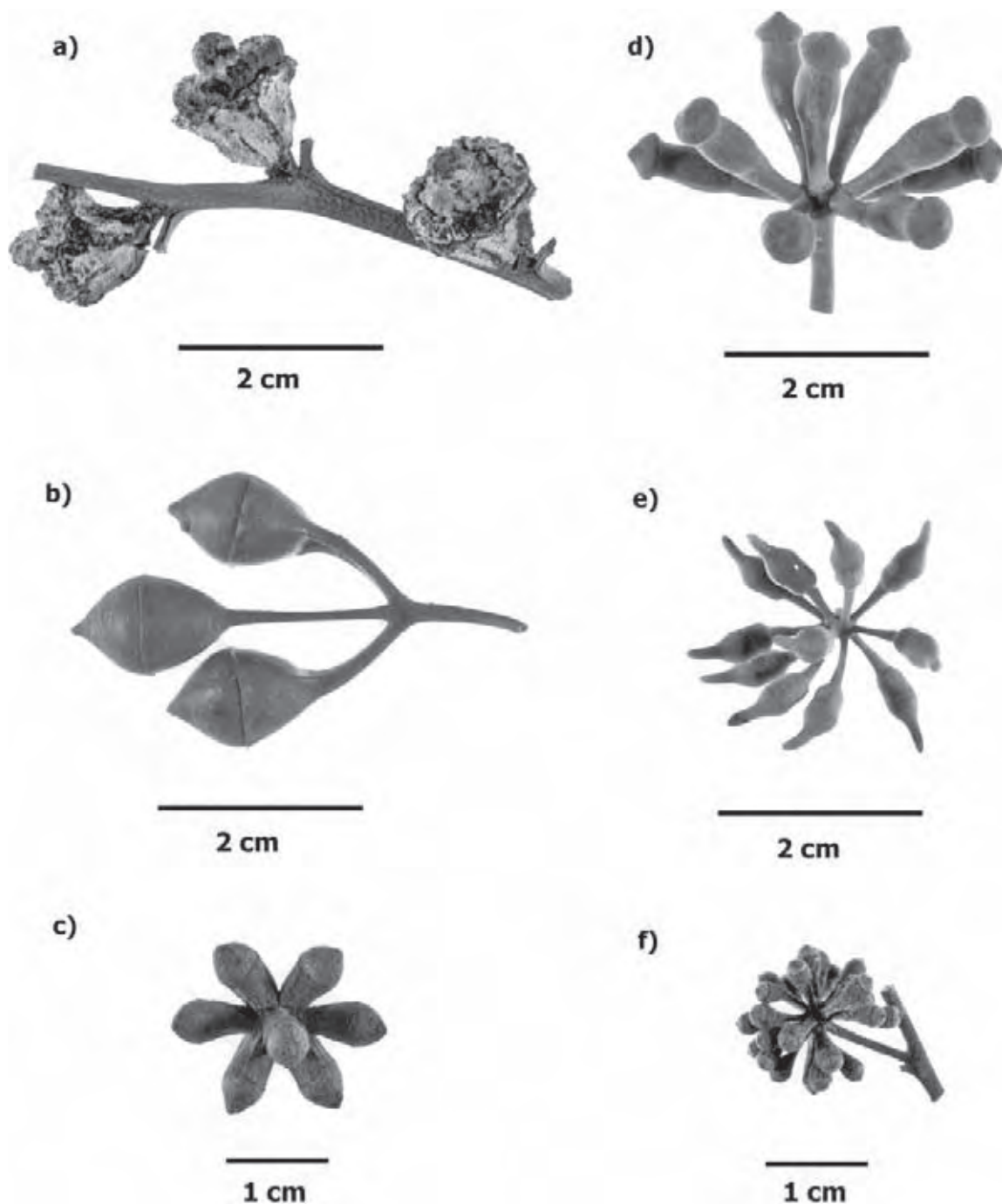


Figure 22. Inflorescences of various species illustrating different bud numbers: (a) 1 (*E. globulus*); (b) 3 (*E. longifolia*); (c) 7 (*E. goniocalyx*); (d) 9 (*E. cladocalyx*); (e) 11 (*E. socialis*); (f) > 11 (*E. amygdalina*).

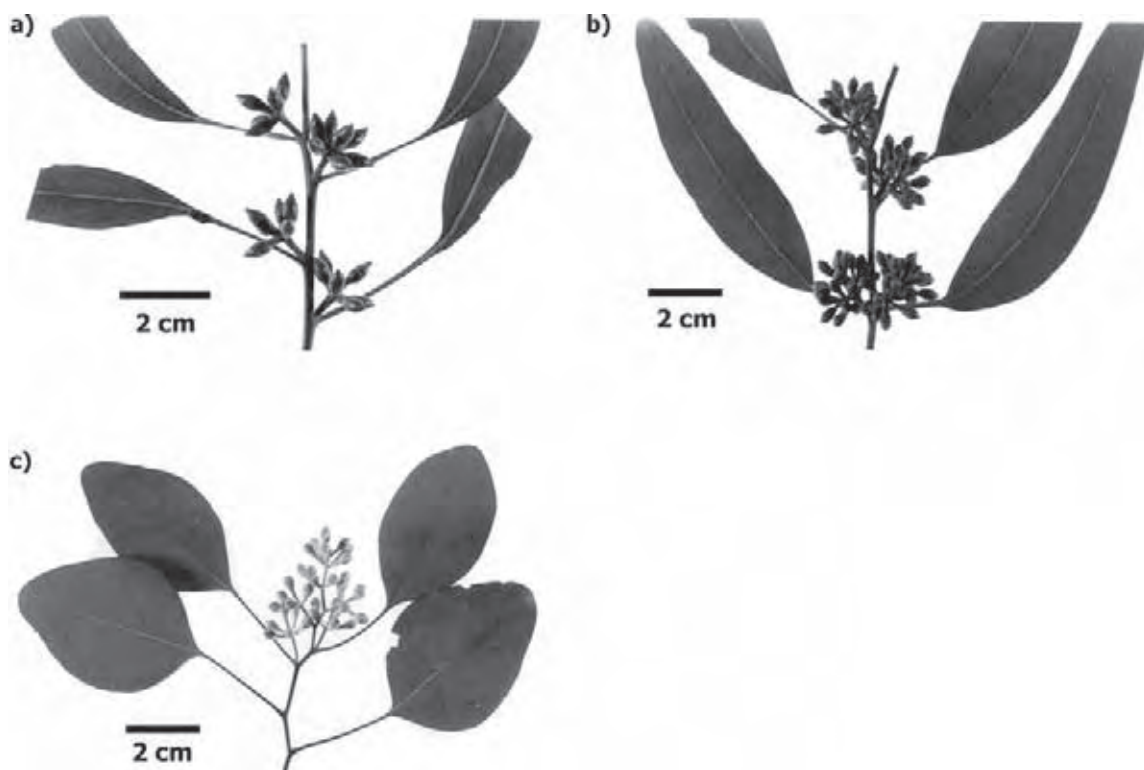


Figure 23. Inflorescence structure: (a) simple, axillary (*E. bridgesiana*); (b) decussate (or compound), axillary (*E. michaeliana*); (c) panicles, i.e. branched (or compound), terminal (*E. polyanthemos*).

tae and ovules, are embedded either partly or wholly within the hypanthium while the style, surmounted by the stigma, is emergent and visible. The essential parts are shown in Fig. 26.

Fruits: After fertilisation the stamens fall and the remainder of the bud matures into a more or less woody fruit, which dehisces loculicidally by

the splitting of the ovary roof into sectors. These spread radially or become erect (i.e. the valves) exposing the chamber contents and allowing the seed to be shed.

Seedlots: The placentae in eucalypt flowers bear ovules in patterns consisting of several vertical and horizontal rows (Fig. 27). Generally the

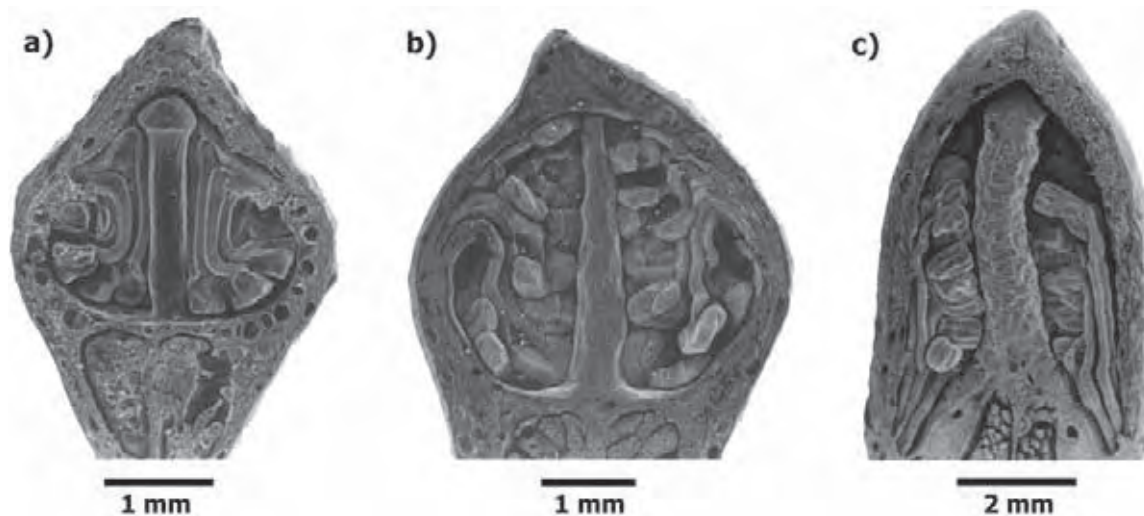


Figure 24. Filament inflexion: (a) inflexed (*E. rudderi*); (b) flexuose (*E. dendromorpha*); (c) erect (*E. tereticornis*).

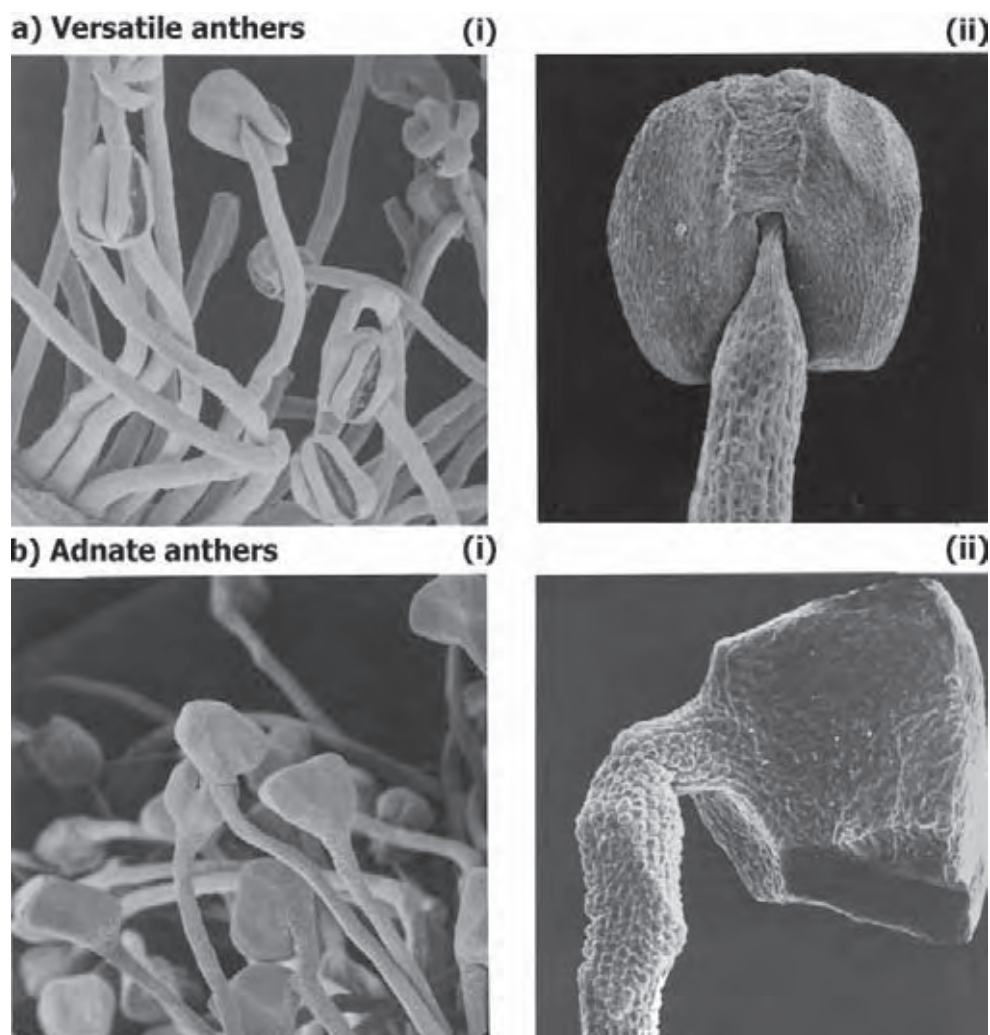


Figure 25. Anther attachment: (a) versatile anthers in (i) *E. viminalis* [×20], (ii) *E. planchoniana* [×50]; (b) adnate anthers in (i) *E. foecunda* [×30], (ii) *E. moluccana* [×100].

upper ovules are not capable of being fertilised and the ovules towards the middle of the placenta do not get fertilised. On maturity their derivatives are shed and are the ‘chaff’ in a seedlot. The lower ovules are fertilised and develop into the viable seed. A eucalypt ‘seedlot’ therefore consists of seeds and chaff (Fig. 28).

Note: While this book treats species that are mainly of commercial value or have been utilised in some way, comment is frequently made in the group digests on other species in the genus. Reference to them is made to illustrate various points of interest that may not involve the species being discussed in the book. For information on these species, more comprehensive treatments of

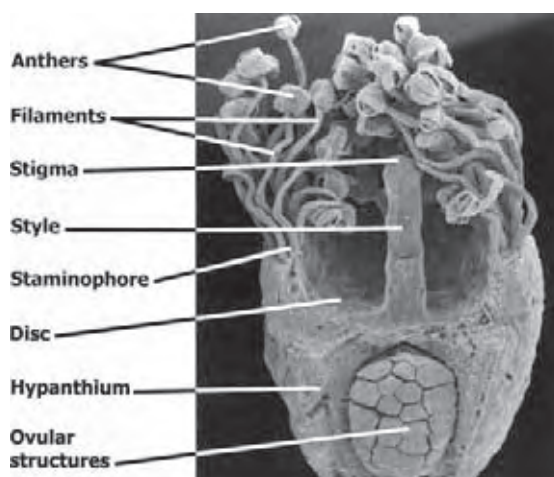


Figure 26. An off-centre longitudinal section of a flower of *E. microtheca* showing various parts [×14].

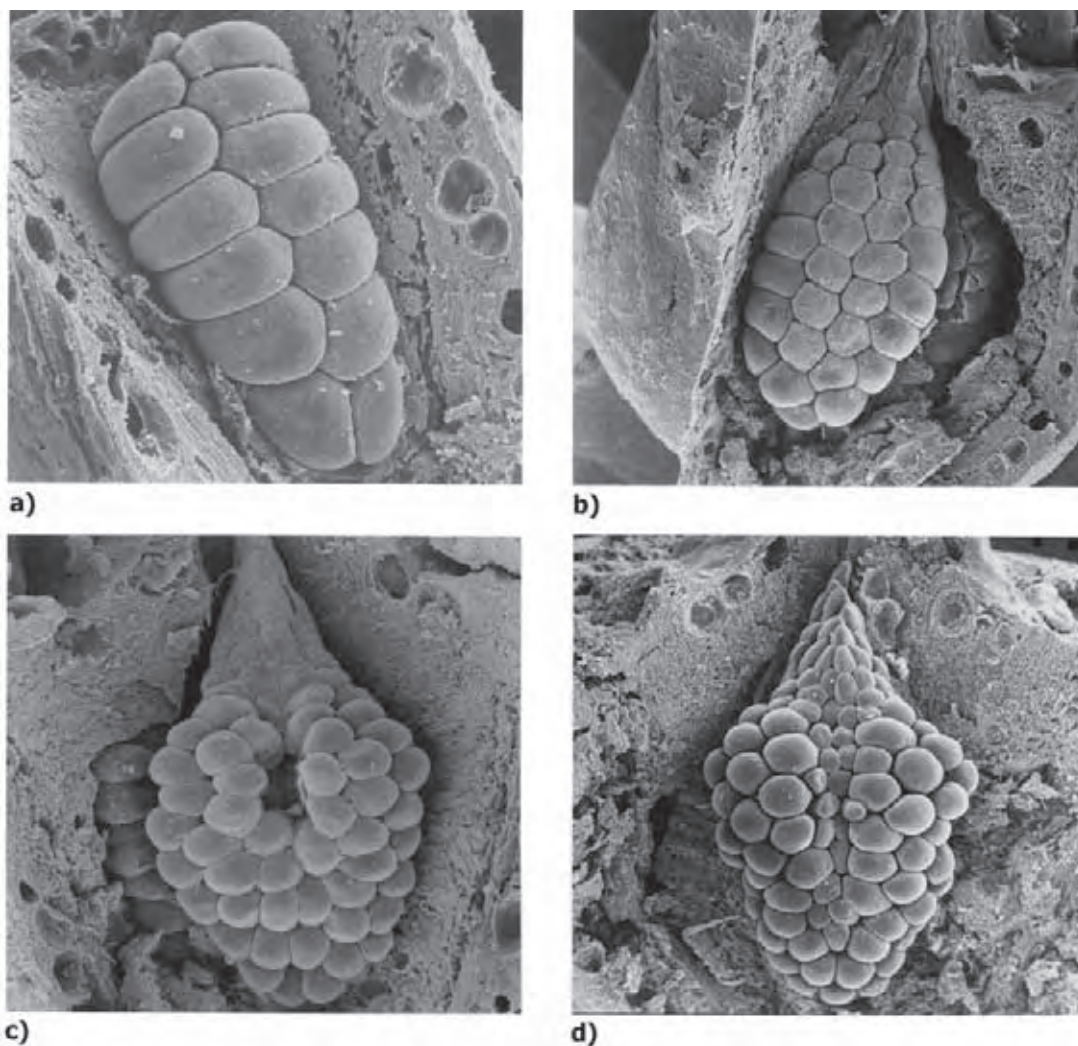


Figure 27. Ovule patterns: (a) two rows (*E. pauciflora*) [$\times 14$]; (b) four rows (*E. flocktoniae*) [$\times 19$]; (c) six rows (*E. blakelyi*) [$\times 20$]; (d) eight rows (*E. pellita*) [$\times 9$].

the genus should be consulted. These include Blake (1953), Blakely (1935), Pryor and Johnson (1971), Chippendale (1973), Hall *et al.* (1970–81), Chippendale (1988), Brooker and Kleinig (1999, 2001, 2004), Hill and Johnson (1995), Nicolle (1997) and Brooker *et al.* (2002).

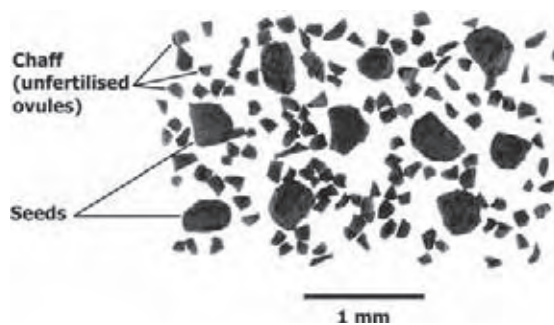


Figure 28. A seedlot of *E. tetradonta* showing the seed and chaff components.

■ Angophoras

Angophora Cav. (1797)

The angophoras or ‘apples’ are endemic to eastern mainland Australia. Chippendale (1988) treated seven species but over twice this number of taxa have been recognised since, e.g. Johnson and Hill (1990) and Hill (1997). The name *Angophora* is from the Greek *angos* (a goblet, vessel), plus *phoros* (carrier), alluding to the shape of the fruit resembling a goblet.

Although a small group, angophoras have a diversity of bark types and a tendency for neoteny (maintaining juvenile foliage at maturity). The rough-barked species include *A. melanoxylon*, *A. robur*, *A. subvelutina*, *A. floribunda*, *A. bakeri*, and *A. woodsiana*. The adult leaves of the first three species have cordate leaf bases and are mostly sessile-leaved (i.e. neotenus or similar to the juvenile leaf phase in this group) and the last three have petiolate adult leaves and attenuate leaf bases. Smooth-barked apple (*A. costata*), which comprises three infraspecific taxa, is the only smooth-barked species. Dwarf apple (*A. hispida*) is a scaly-barked, sprawling mallee with

juvenile foliage when reproductively mature (neotenus). All species have opposite adult leaves and flowers bearing white petals rather than an operculum or fused petals, typical of other eucalypt groups.

Despite being a relatively small group by eucalypt standards, the taxonomy of species is somewhat unstable as botanists differ in concepts of status, rank or even recognition of species. For example, see a revision of the genus by Leach (1984) and a cladistic analysis by Thiele and Ladiges (1988), or Johnson and Hill (1990), Hill (1997) and Brooker *et al.* (2001). Based on DNA markers, Steane *et al.* (2002) showed that *Angophora* is closely allied to bloodwood eucalypts (subgen./genus *Corymbia*). This conclusion closely reflects the earlier morphological assessment of Pryor and Johnson (1971). In emphasising their affinities Pryor and Johnson refrained from reducing *Angophora* to subgenus rank within *Eucalyptus sens. lat.* as they cautioned that other subgenera may warrant upgrading in the future (viz. *Corymbia*). Brooker (2000), however, subsumed *Angophora* as a subgenus under *Eucalyptus*, a concept which does not appear to have been accepted in any publications to date.



Smooth-barked apple (*Angophora costata*), near Bulahdelah, N.S.W. showing its distinctive undulating crown branching (1) and its occurrence on skeletal ridgetop soils (2) (images: O. Strewé).

Smooth-barked Apple Smooth-barked Angophora, Sydney Red Gum

Angophora costata (Gaertner) Britten

Smooth-barked apple is usually a medium-sized tree attaining 15–25 m in height and 0.5–1 m in diameter. On adverse, rocky, sandstone sites near Sydney, trees are irregularly branched having rather large open crowns and very short boles. Under more favourable conditions it grows taller and to 1.2 m in diameter, with a symmetrical, straight bole at least half the tree height. Three subspecies are recognised.

Subsp. *costata* occurs mainly on the Central Coast of New South Wales where it is plentiful but extends south to Narooma, north to Coffs Harbour and west to the Blue Mountains. A mysterious, highly disjunct outlier occurs in central northern Queensland in the White Mountains near Pentland. Subsp. *euryphylla* occurs in a restricted area near Putty, Howes Valley and on Judge Dowling Range in New South Wales, while subsp. *leiocarpa* occurs from Narrabri in north-eastern New South Wales, north to Tambo, the Blackdown Tableland and Rockhampton in Queensland, including occurrences on Moreton and Fraser Islands.

These taxa grow on a wide range of sites from small flats on the coast to the ridges of mountains and on inland plains. Subsp. *costata* and subsp. *euryphylla* are common on skeletal sandy soils while subsp. *leiocarpa* occurs on deep to skeletal, alluvial sands. Soils are mainly derived from sandstone or granite.

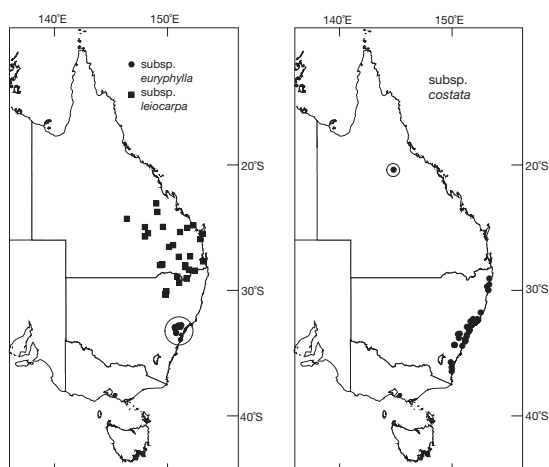
Smooth-barked apple grows in open forests in association with many tree species, including blackbutt (*E. pilularis*), bloodwoods (*E. eximia*, *E. gummifera*, *E. intermedia*, *E. citriodora*), white mahoganies (*E. umbra*, *E. acmenoides*), red mahogany (*E. scias*), grey gums (e.g. *E. punctata*), stringybarks (e.g. *E. agglomerata*), cypress pines (*Callitris* spp.) and turpentine (*Syncarpia glomulifera*).

Related species: Smooth-barked apple is distinguished from all other angophoras by its smooth bark. Subsp. *euryphylla* and subsp. *leiocarpa* are treated at species rank by some botanists, e.g. Johnson and Hill (1990) and Hill (1991).

Publication: *Angophora costata* (Gaertner) Britten, *J. Bot.* 54, 62 (1916). Type: Botany Bay, New South Wales, 1770, J. Banks and D. Solander. Subsp. *euryphylla* L.A.S. Johnson ex G.J. Leach: *Telopea* 2, 759 (1986). Type: 3 km NW of Gibbs Place, Putty, N. S.W., 26 Apr. 1971, J. Pickard 1639. Subsp. *leiocarpa* L.A.S. Johnson ex G.J. Leach: *Telopea* 2, 760 (1986). Type: Just south of Warialda, near High School, 25 Aug. 1976, G.J. Leach 423.

Names: Botanical—*costata*, from the Latin *costa* (a rib, side), in reference to the ribbed fruit; Greek *eury* (broad), *phyllon* (leaf); Greek *leio* (smooth), *carpos* (fruit). Common—‘apple’ is believed to have originated from the apple-tree appearance of the first observed species, *A. hispida*.

Bark: Shed from the whole of the stem and branches, in irregular oval, thin plates or scales of often boat-shaped appearance, usually leaving a slightly dimpled surface. The newly revealed surface is bright orange-brown or pink-brown, but becomes grey with age.



Leaves: Cotyledons—petiolate, orbicular, about 1.5×1.5 cm. Seedling—opposite, sessile, more or less oblong, 10–15 \times 4–5 cm, pale green, discolorous. Adult—opposite to subopposite, shortly petiolate about 1–2 cm long, lanceolate or narrowly oblong, about 7–13 \times 1.5–3 cm, bright green, discolorous; side venation parallel, closely spaced; new leaves are bright red in colour.

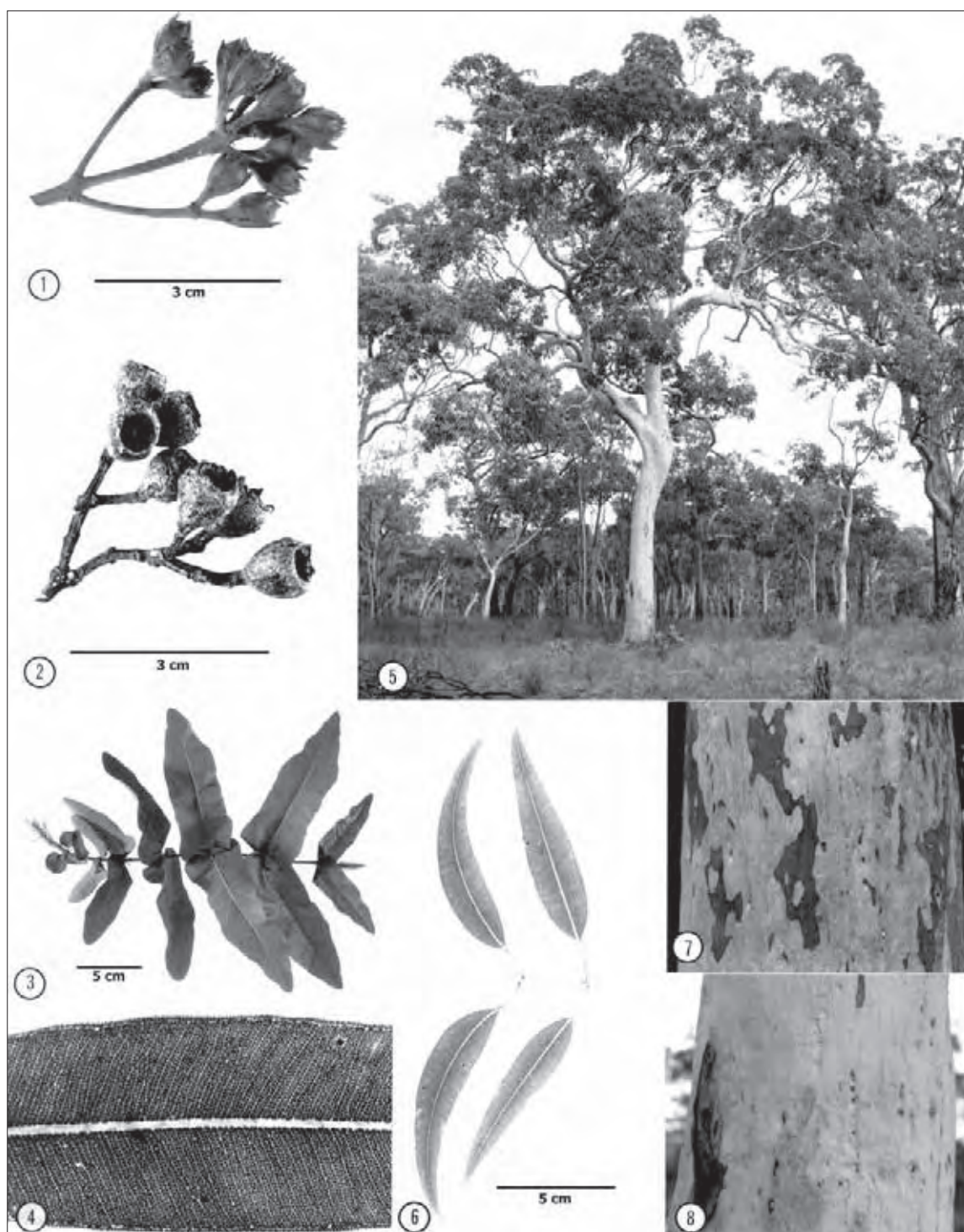
Inflorescences: Terminal, compound, 3-flowered (rarely 7) unit inflorescences; peduncles to 2 cm long, shortly pedicellate (pedicels to 0.4 cm long), buds ovoid or globular, 0.6–1 \times 0.5–0.8 cm; pedicels and peduncles sparsely covered by short bristles; sepals occur as 5 small, persistent teeth (which become woody on the fruit); petals 5, free, spreading, stamens numerous, arranged in several whorls. Flowers Oct.–Dec.

Fruits: Pedicels 0.5–0.8 cm long; ovoid or campanulate, 1.3–1.5 \times 1.2–1.5 cm (*costata*, *leiocarpa*) or 1.5–2.1 \times 1.4–2.0 cm (*euryphylla*), slightly woody (*costata*, *euryphylla*), or thin-walled and papery (*leiocarpa*); costate with 5 main ribs and 5 or more minor ones (*costata*, *euryphylla*) or smooth (*leiocarpa*), 5 small teeth on the rim extending to 0.2 cm and usually 3(4) deeply enclosed deltoid valves. Seeds red-brown, flattened-ellipsoidal, hilum ventral.

Wood: Sapwood pale, up to 5 cm wide, subject to attack by *Lyctus* borer; heartwood light pinkish brown, very hard, not durable and should not be used in contact with the ground; moderately coarse-textured and with rather interlocked grain, numerous concentric kino (gum) veins, moderately strong, density 755–1045 kg m⁻³. The timber is rarely milled, but has been used for rough flooring, slabs, fence rails and palings and for a time it was mixed with eucalypts for the manufacture of hardboard. It is a good fuel wood.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 25–35°C/0–8°C; Frost incidence: low to high (up to 50 each year at inland sites); Rainfall: 600–1200 mm, summer max.

Distinctive features: Similar in appearance to typical gum-barked eucalypts but differs by flowers with petals or the absence of opercula, the bristly buds, the opposite, discolorous leaves and the only slightly woody fruit with several small teeth at rim level.



Angophora costata 1. Floral buds 2. Fruits 3. Seedling 4. Venation of adult leaf 5. Tree, Charmhaven, N.S.W.
6. Adult leaves 7, 8. Bark variation

Rough-barked Apple Apple, Apple Box (Qld)

Angophora floribunda (Smith) Sweet

Rough-barked apple is a medium-sized tree, attaining 12–20 m in height and 0.5–1 m in diameter. Trees usually have a large, light green coloured crown with noticeably contorted branches. The trunk is usually short in open grown trees.

Rough-barked apple occurs in the far east of Victoria but principal occurrences are in New South Wales, where it is found along south coastal areas and inland of the Great Dividing Range in the northern parts of the State. It is noticeably absent from much of the north coast of New South Wales and mostly absent from the Moreton District of Queensland. In Queensland it extends from the border northwards towards Rockhampton and inland towards Springsure, Roma and Goondiwindi. There is a small isolated occurrence in northern Queensland, near Atherton.

This species is commonly found on undulating topography but extends to plains. Best development is on alluvial soils and deep sandy loams on flats and along watercourses. It also occurs on shallower and more compact soils, and in Victoria and the South Coast of New South Wales the species is mainly on coastal sandy soils.

Rough-barked apple is mainly a species of open forests or woodlands. Over its wide distribution it is associated with many other eucalypts, as well as cypress pines (*Callitris* spp.). In coastal areas it may occur as a minor species with eucalypts such as forest red gum (*E. tereticornis*) on river flats and on other sites, with grey gums (*E. punctata*, *E. propinqua*), bloodwoods (mainly *E. gummifera*), various stringybarks, white mahogany (*E. acmenoides*) and blackbutt (*E. pilularis*). Inland associates include ironbarks, grey boxes, some of the red gums and cypress pines (*Callitris* spp.).

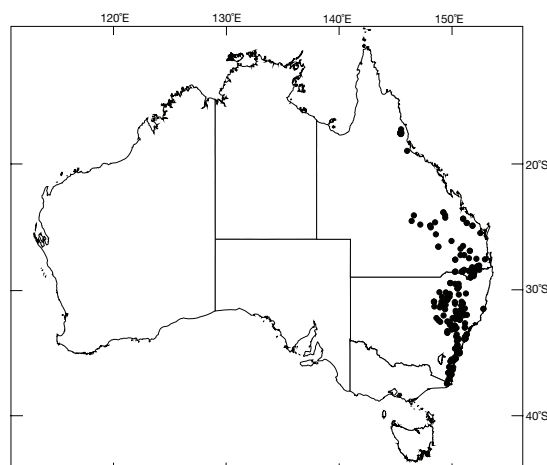
Related species: Rough-barked apple is related to narrow-leaved apple (*A. bakeri*) and *A. woodsiana*, which also have rough bark and petiolate adult leaves. *A. bakeri* is a smaller tree and has narrower adult leaves (0.5–1 cm wide). *A. woodsiana* usually has larger fruits (1.1–1.5 × 1–1.6 cm), longer pedicels (usually more than 1.5 cm long) and longer petioles (1.2–2 cm long). Hill (1997) described *A. inopina* from the Wyee area just north of Sydney which appears to represent a stunted coastal ecotype of rough-barked apple.

Publication: *Angophora floribunda* Sweet, *Hortus Brit.* edn II, 209 (1830). Type: Port Jackson, New South Wales, 1795, J. White.

Names: Botanical—*floribunda*, from the Latin *flos, floris* (flower), *abundus* (abounding in), alluding to prolific flowering. Common—the first part ‘rough-barked’ alludes to the character of the bark and ‘apple’ is believed to have originated from the apple-tree appearance of the first observed species, *A. hispidula*.

Bark: Rough bark persistent to the small branches, thick, shortly fibrous and friable; irregularly cracked; light brown.

Leaves: Cotyledons—petiolate, orbicular to transversely broadly elliptical, cordate, 1–1.5 × 1.1–1.8 cm. Seedling—opposite, sessile, ovate or oblong, 6–8 × 3–4 cm, pale green, discolorous; stems slightly bristly. Adult—opposite, short



strap-like petioles which are 0.5–1.5 cm long, oblong to lanceolate, 7–12 × 1.5–2.5 cm, discolorous, dull green above, paler below with a yellow tint; venation moderately conspicuous, side veins closely spaced.

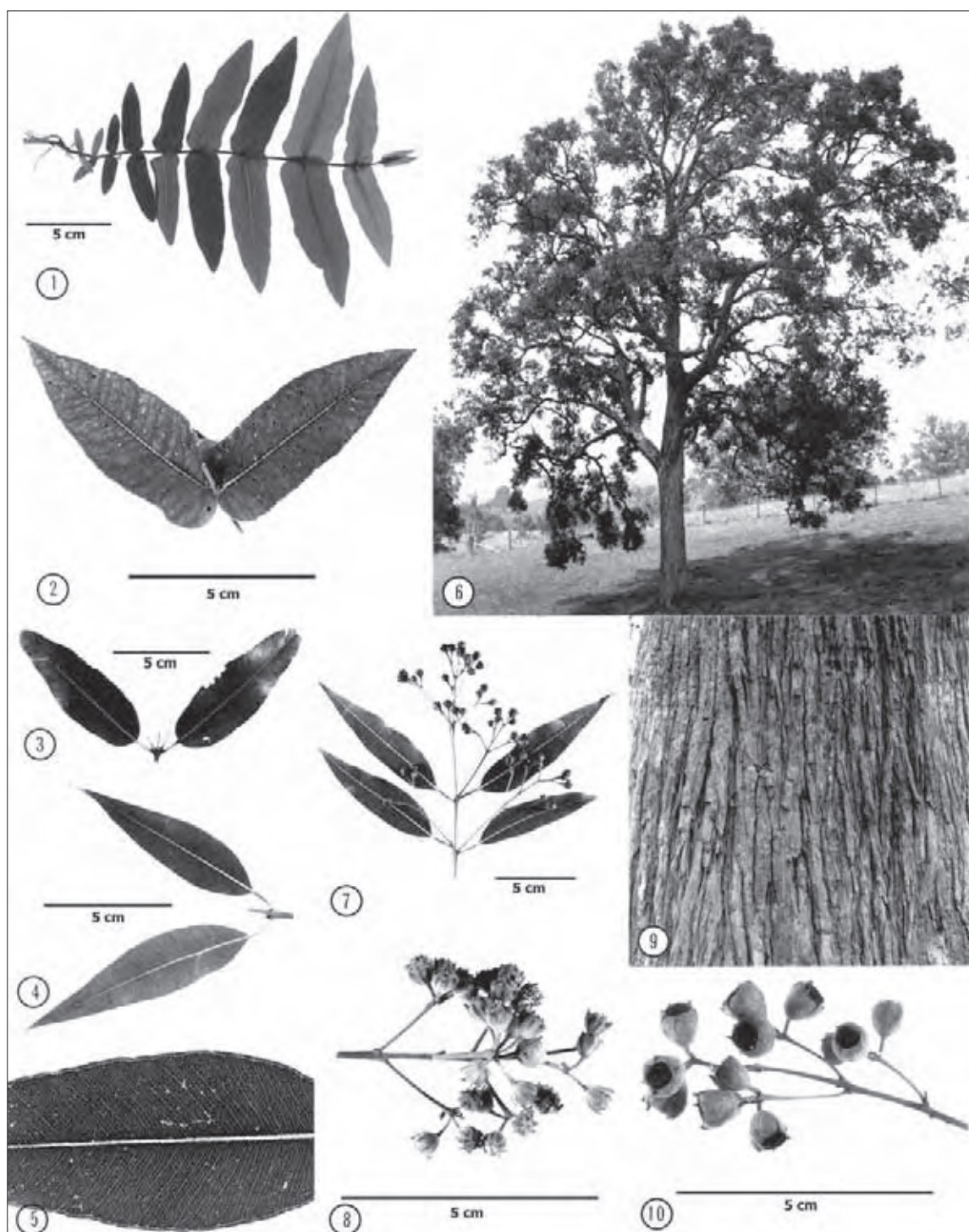
Inflorescences: Terminal, compound, 3 or 7-flowered unit inflorescences; peduncles 1–2.5 cm long, pedicels 0.4–1 cm long; buds ovoid, 0.4–0.5 × 0.4–0.5 cm, with sparse fine bristles to 0.2 cm long on the pedicels and peduncles; sepals occur as 5 small, persistent teeth (which become woody on the fruit); petals 5, free, orbicular, about 0.2 × 0.2 cm, spreading; stamens numerous, arranged in several whorls. Flowers Aug.–Nov., produces copious nectar.

Fruits: Pedicellate 0.5–1 cm long, ovoid or cylindrical, 0.8–1 × 0.8–1 cm, often narrowed at the rim, with 5 main ribs and 5 or more minor ones, 5 small teeth to 0.1 cm long on the rim and 3 or 4 deeply enclosed valves; thin and rather fragile; fruits and pedicels often hairy. Seeds red-brown to brown, flattened-ellipsoidal, hilum ventral.

Wood: Sapwood pale, may be 3–6 cm wide, susceptible to *Lyctus* attack; heartwood pink to light reddish brown, hard, coarse-textured, tough, strong, moderately durable, straight grained sometimes interlocked, but kino (gum) veins common, density 800 kg m⁻³. The timber is rarely sawn but is sometimes used for fencing, rough farm buildings and fuel wood. Better quality logs would yield flooring, cladding and panelling.

Climate: Altitudinal range: near sea level to 800 (–1100) m; Hottest/coldest months: 21–32°C/0–10°C; Frost incidence: low to high; Rainfall: 500–1500 mm per year, summer max.

Distinctive features: With its fine, contorted branching, rough-barked apple is less likely to be mistaken for a eucalypt than smooth-barked apple, though it has some similarities in appearance. The tree is very useful for shade and shelter in the drier parts of its range. The foliage is harsh and has a low nutritive value, but constitutes a useful reserve stock fodder during periods of severe drought, as the tree will withstand heavy lopping. The flowers produce pollen abundantly and the tree is considered useful by beekeepers, but the honey is of inferior quality.



Angophora floribunda 1. Seedling 2. Juvenile leaves 3. Intermediate leaves 4. Adult leaves 5. Venation of adult leaf 6. Tree, near Bemboka, N.S.W. 7. Inflorescences 8. Buds 9. Bark 10. Fruits

■ Ghost Gums (or Paper-fruited Bloodwoods)

Eucalyptus subgenus *Blakella* Pryor & Johnson ex Brooker (2000)

Corymbia section *Blakearia* Johnson & Hill (1995)

This group comprises about 20 species depending on which taxonomic perspective is followed and ranges from small to moderately large trees up to 35 m tall. The species are distributed widely in the northern half of Australia and at least three occur in New Guinea. They are absent from the winter rainfall areas but show a wide tolerance in tropical and subtropical regions ranging from arid central Australia to the wet, humid areas of coastal Queensland.

The wood of carbeen (*E. tessellaris*) is of commercial value and the species is widely distributed in both the drier and wetter areas of Queensland from Cape York to northern New South Wales, although absent from the most arid regions. In recent years a number of ghost gum species have become important in mine-site revegetation programs. A few species of the group are of ornamental value including carbeen which is an erect tree with delicate foliage and strongly tessellated basal bark, but perhaps the best known species is the ‘original’ ghost gum (*E. aparrerinja*, often incorrectly referred to as *E. papuana*, which is distributed in New Guinea and probably Cape York Peninsula, Queensland) of the arid and tropical regions which has been made famous by the Aboriginal artists of central Australia. The Tree of Knowledge at Barcaldine in central Queensland is a ghost gum.

The common name ‘bloodwood’ has been applied to both the paper-fruited *Blakella* and the woody-fruited *Corymbia* species. Although quite separate groups of species they often have in common distinctly tessellated bark (in the case of *E. aparrerinja* and *E. grandifolia* this is normally absent but often appears after fire when the dead bark cracks). In these species the outer, dead bark is not deciduous as in the smooth-barked gums and, being short-fibred, it cracks into roughly square or rectangular pieces

(tesserae) giving a regular scaly appearance. The fruits of the two groups are superficially similar in shape but they are easily distinguished by the thickness of the wall of the mature fruits—hence the older common names paper-fruited and woody-fruited bloodwoods. In this edition we refer to the paper-fruited bloodwoods as ghost gums and to the woody-fruited bloodwoods simply as bloodwoods.

The ghost gum and the bloodwood groups are related to the angophoras of eastern Australian forests and woodlands. These three groups, plus the genera *Allosyncarpia* from Arnhem Land in Northern Territory, *Arillastrum* which is endemic to New Caledonia, *Eucalyptopsis* from New Guinea and *Stockwellia* known only from the Atherton Tableland in north Queensland, are considered to make up a discrete evolutionary lineage that appeared in the early radiation of the eucalypts (Johnson and Briggs 1984). They exhibit certain unmodified or primitive characters (petals in *Angophora*, apparently terminal or compound inflorescences in ghost gums and bloodwoods), which place them apart from the other eucalypt groups (though apparently terminal inflorescences occur as well in most boxes and ironbarks).

Botanically the ghost gums are characterised by inflorescences that are decussately arranged umbels on axillary rhaches (cf. bloodwoods) but this main rhachis is often shortened obscuring the true arrangement. A similar inflorescence occurs outside *Blakella* in only *E. cloeziana* (subgenus *Idiogenes*) and *E. michaeliana* (subgenus *Symphyomyrtus*). The *Blakella* species differ clearly from these others, however, in the thin-walled fruits among other characters.

Some ghost gum species have a stocking of tessellated bark while others are wholly smooth. Some of the species have seedlings with unbranched hairs on the leaves and stems. The adult leaves have numerous side veins, pinnately arranged, dense reticulation and few oil glands. The tissue between the intramarginal vein and the leaf edge is reticulate, contrasting with that of the bloodwoods. The leaves in carbeen (*E. tessellaris*), scarp gum (*E. kombolgiensis*) and a few

other ghost gums are narrow while in other species they are broad, undulate and stiff to the touch. In species such as Brittle Range gum (*E. aspera*) and broad-leaved carbeen (*E. confertiflora*) the mature canopy is composed of juvenile to intermediate leaves, which are scabrid. Some tropical species in the group are deciduous during the dry season (e.g. *E. confertiflora*).

The flower buds are usually pedicellate and clavate. They lose their outer operculum early in development unlike most of the bloodwoods. The filaments of the stamens in bud are strongly

inflexed. The anthers are oblong, versatile, and open by longitudinal slits. The fruits are notably thin-walled. They mature and shed seed rapidly—sometimes within days of flowering which makes seed collection of these species difficult as many occur in remote areas. The seeds are circular or saucer-shaped, thin, and the cotyledons within pressed together unfolded.

Taxonomically, the ghost gums divide into two sections, those with an extended main rachis of the inflorescences (*Extensae*) and most with a contracted rhachis (*Abbreviatae*).



Ghost gums, subgenus *Blakella*, were somewhat controversially included in *Corymbia* by Hill and Johnson (1995). Due to differences in their cotyledon anatomy, inflorescences and fruit structure some botanists consider they should be regarded as a separate monophyletic group. The ghost gum (*E. aparrerinja*) shown here near the Todd River, east of Alice Springs, N.T., has attained exceptionally large proportions for this species.

Carbeen Moreton Bay Ash

Eucalyptus tessellaris F. Muell. [*Corymbia tessellaris* (F. Muell.) K.D. Hill & L.A.S. Johnson]

Carbeen varies from a medium-sized tree 12–15 m in height to a tall, graceful tree attaining 35 m in height and 1 m dbh. The crown has slender branches with pendulous branchlets. The trunk is almost always straight and from half to two-thirds of the total tree height. The form of carbeen is affected by wind shear on exposed coastal sites.

Carbeen occurs from northern New South Wales through most of the eastern half of Queensland, extending to the northernmost tip of Cape York Peninsula. It also occurs in south-western Papua New Guinea.

Carbeen occurs on extensive plains and on undulating topography on many soil types. Best growth is on deep sandy loams derived from sedimentary rocks, and on alluvial soils.

In higher rainfall areas near the coast this species occurs in open forests, while in the drier inland sites it is found in woodlands. In coastal sites it may be associated with rainforest or vine forest species. Common eucalypt associates include poplar box (*E. populnea*), silver-leaved ironbark (*E. melanophloia*), narrow-leaved ironbark (*E. crebra*), forest red gum (*E. tereticornis*), white gum (*E. platyphylla*) and Clarkson's bloodwood (*E. clarksoniana*). Other genera include *Acacia*, *Casuarina* and *Callitris* as well as numerous rainforest species.

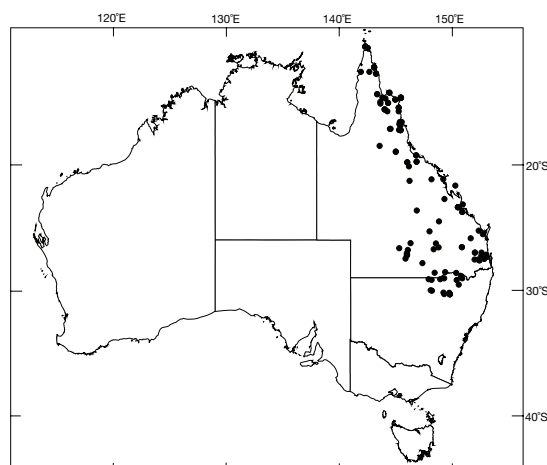
Related species: Brooker (2000) placed carbeen in section *Extensae*, defined by the extended rachis of the inflorescence. It is related to at least two other species, namely northern ghost gum (*E. bella*), which differs by the completely smooth bark and is widely distributed across northern Australia from Broome and Cape Leveque in Western Australia to east of Croydon in Queensland. The other species is ghost gum (*E. papuana*), which differs by the loose rough basal bark, the much broader juvenile leaves and occurs in New Guinea and probably in northern Cape York Peninsula. In the field, the distinctive stocking of rough tessellated bark and crown of pendulous, narrow leaves makes carbeen unlikely to be confused with any other tree species.

Publication: *Eucalyptus tessellaris*: J. Linn. Soc. Bot. 3, 88 (1859). *Corymbia tessellaris*: *Telopea* 6, 402 (1995) Neotype: Near Laidley, Queensland, 25 Jan. 1926, S.T. Blake 10409 (see the protologue *loc. cit.* for discussion regarding the neotype of this species).

Names: Botanical—Latin *tessellaris* (tessellated), referring to the basal bark. Common—of Aboriginal origin.

Bark: Rough bark persistent on the lower part of the trunk from around 1–4 m, dark grey with numerous horizontal and vertical cracks forming separate square or rectangular segments (tessellated), with an abrupt change to smooth, white or greyish white bark above.

Leaves: Seedling—opposite for 7–10 pairs then alternate, sessile to very shortly petiolate, ovate to broad-lanceolate, 4–12 × 1.5–4.5 cm, dull greyish green, slightly discolourous. Juvenile—alternate, shortly petiolate, lanceolate, 12–24 × 3–5 cm, dull greyish green, slightly discolourous. Some simple hairs occur in the seedling and juvenile stages, mainly



on the veins and midrib of the underside of the leaves.

Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 15–25 × 2–4 cm, dull greyish green, concolorous.

Adult—alternate, petiolate, lanceolate to linear, 10–20 × 0.7–2 cm, dull greyish green, concolorous.

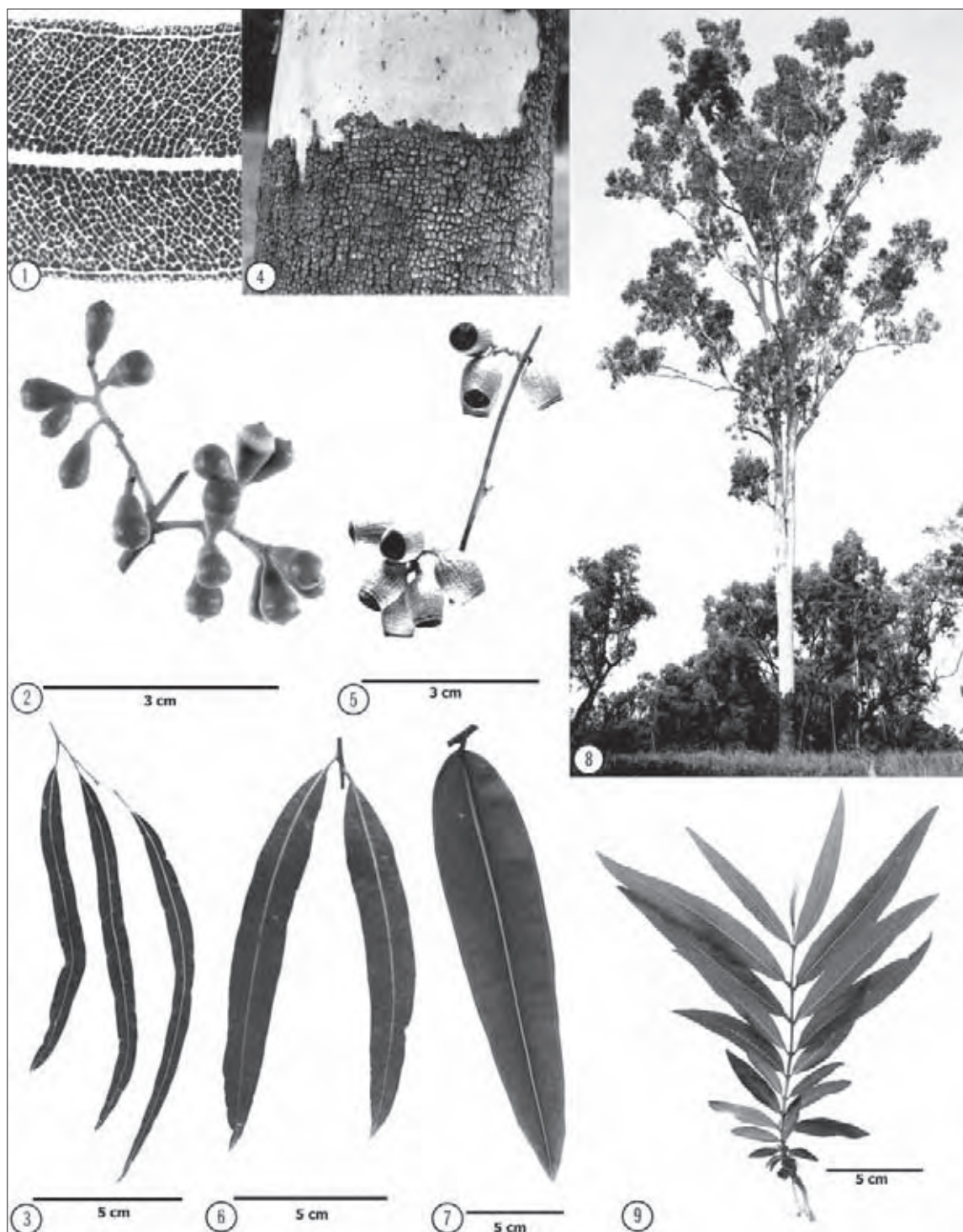
Inflorescences: Axillary, compound, 3 or 7-flowered unit inflorescences arranged decussately along an extended rachis; peduncles angular, 0.2–0.7 cm long; pedicels angular, 0.1–0.3 cm long (angles on the pedicels continue up the hypanthia as faint ribs); buds ovoid or pyriform, 0.4–0.7 × 0.3–0.5 cm; opercula hemispherical, usually apiculate. Flowers Oct.–Feb.

Fruits: Pedicellate, urceolate or cylindrical, 0.5–1.2 × 0.5–0.9 cm, thin-walled, fragile; disc broad, steeply descending; valves 3, deeply enclosed. Seeds circular, thin, red-brown, hilum ventral. Mature Jan.–Mar.

Wood: Sapwood light brown, susceptible to attack by *Lyctus* borers; heartwood dark chocolate brown, fine-textured, tough, very hard, strong, kino (gum) veins common, somewhat greasy; density about 1090 kg m⁻³; used to a limited extent for general construction purposes with good wearing properties, and as sawn and round timber in wharf and bridge construction, mining timber, railway sleepers and piles.

Climate: Altitudinal range: near sea level to 900 m; Hottest/coldest months: 31–37°C/3–20°C; Frost incidence: low to moderate (up to 10 each year at southern inland sites); Rainfall: 400–3500 mm per year, summer max.

Distinctive features: Lower trunk with a distinctive stocking of tessellated rough bark, smooth above; usually pendulous branchlets and narrow leaves; elongated compound axillary inflorescences; fragile, thin-walled fruits, shed from tree very shortly after maturing.



Eucalyptus tessellaris 1. Adult leaf venation 2. Buds 3. Adult leaves 4. Bark 5. Fruits 6. Intermediate leaves 7. Juvenile leaf 8. Tree, between Augathella and Tambo, Qld 9. Seedling

Ghost Gum *Aparrerinja*, White Gum

Eucalyptus aparrerinja (K.D. Hill & L.A.S. Johnson) Brooker [*Corymbia aparrerinja* K.D. Hill & L.A.S. Johnson]

Ghost gum varies in size from a small, crooked tree 5–10 m tall to a medium-sized tree up to 25 m in height and 1 m dbh. The trunk is generally short and the branches large and spreading. It is reduced to a small straggly tree on harsh sites such as the stony ranges in the centre of the continent. This species of ghost gum is the famous smooth, white-barked tree of central Australia, depicted in the paintings of Albert Namatjira and other Aboriginal artists.

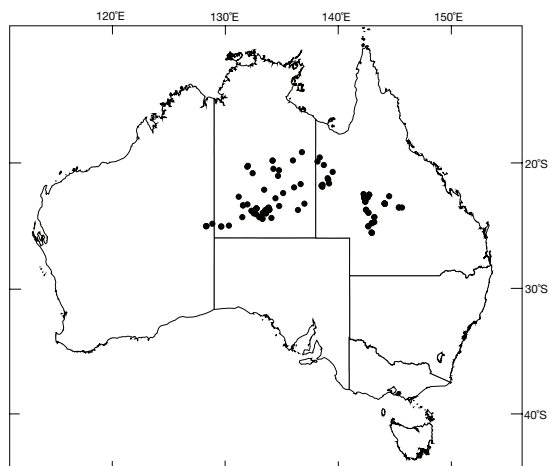
Ghost gum is widely and sporadically distributed in arid central regions from Giles in Western Australia, across the central and southern part of the Northern Territory to western and central Queensland. It occurs as far north as Tennant Creek in the Northern Territory and east to Barcaldine in Queensland.

The best-known occurrences of ghost gum are along the creeks and riverbeds in sandstone ranges of central Australia. However, it also occurs on alluvial flats, undulating hills, plateaux and cliff faces. Soils range from red siliceous desert sands, sandy red earths to skeletal sandy loams derived from sandstone, quartzite or laterite.

Ghost gum occurs in a range of woodland formation types often without associated eucalypts, particularly where it occupies plains or stony hills dominated by spinifex (*Triodia* species) and sometimes mulga (*Acacia aneura*). When eucalypts are present they include river red gum (*E. camaldulensis*) and bloodwoods (*E. eremaea*, *E. setosa*, *E. terminalis*) and in Queensland poplar box (*E. populnea*) and Normanton box (*E. normantonensis*). Acacias include ironwood (*A. estrophiolata*), gidgee (*A. georginae*) and gundabluey (*A. victoriae*). Beefwood (*Grevillea striata*) is occasionally present.

Related species: Brooker (2000) placed ghost gum in section *Abbreviatae* which is defined by the shortened rachis of the inflorescence and comprises a group of a dozen or more species. In the *Abbreviatae*, it is often difficult to see the individual unit inflorescences because of their complex and crowded structure, but they have been reported as 7-flowered. This section comprises two series, one with rough bark (*Clavigerae*), and the other with smooth bark (*Scutiformes*). Ghost gum belongs in the latter series and is distinguished by the narrow, glabrous, shiny adult leaves in the mature crown. It may be difficult to distinguish from *E. aparrerinja* subsp. *dallachiana* (= *Corymbia dallachiana*) and *E. flavescens*, particularly in areas where they form intergrades; see Hill and Johnson (1995) for discussion.

Publication: *Corymbia aparrerinja*: *Telopea* 6, 453 (1995); *Eucalyptus aparrerinja*: *Aust. Sys. Bot.* 13, 137 (2000). The species name was originally published as *E. papuana* F. Muell. var. *aparrerinja* Blakely in 1934. Without a Latin diagnosis, the publication was invalid. Its recent valid publication redressed Blakely's incorrect association of this species of ghost gum with *E. papuana*, which belongs to another taxonomic section. Type: Gosse Range, SW Macdonnell Ranges, May 1925, H. Basedow.



Names: The name 'aparrerinja' is the rendering in English of the Aboriginal name for the species.

Bark: Smooth over whole trunk, white, powdery, shedding seasonally in thin scales.

Leaves: Seedling—opposite, shortly petiolate, ovate, 7.5–10 × 2.8–5 cm, dull, grey-green, slightly discolorous; stems slightly scabrid for a few nodes, midrib usually scabrid. Juvenile—subopposite to alternate, shortly petiolate, ovate to broad-lanceolate, to 18 × 6 cm, glabrous, grey-green. Intermediate—opposite to alternate, shortly petiolate, ovate to broad-lanceolate, to 10 × 5 cm, green, concolorous. Adult—subopposite to alternate, petiolate, lanceolate to narrow-lanceolate, very variable, 5–16 × 0.7–2 cm, glossy green, concolorous.

Inflorescences: Compound, in axils of leaves, whole inflorescences crowded, unit inflorescences 3 or 7-flowered; peduncles obscure; pedicels 0.2–0.5 cm long; buds ovoid to pyriform, 0.6–0.7 × 0.5–0.6 cm; opercula hemispherical-apiculate. Flowers Nov.–Feb.

Fruits: Shortly pedicellate, cupular to cylindrical, 0.8–1.3 × 0.7–0.9 cm, thin-walled; disc descending; valves deeply enclosed. Seeds circular, thin, red-brown, hilum ventral. Mature Dec.–Mar.

Wood: Sapwood narrow and pale; heartwood dark red-brown, not very hard and subject to termite attack; density about 1000 kg m⁻³; in central Australia it is used for general building purposes in areas where timber is scarce, but elsewhere it is not highly regarded.

Climate: Altitudinal range: 130–950 m; Hottest/coldest months: 35–37°C/4–8°C; Frost incidence: low to moderate; Rainfall: 250–650 mm per year, summer max.

Distinctive features: Small to medium-sized tree, usually with spectacular, smooth white bark; leaves glossy green; unit inflorescences crowded; pedicels short; thin-walled fruits that quickly shed seeds. Ghost gum is an important tree in the Aboriginal mythology of central Australia.



Eucalyptus aparrerinja 1. Buds 2. Fruits 3. Seedling 4. Tree, near Alice Springs, N.T. 5, 7. Bark 6. Juvenile leaves 8. Intermediate leaves 9. Adult leaf venation 10. Adult leaves

Broad-leaved Carbeen Rough-leaved Cabbage Gum

Eucalyptus confertiflora F. Muell. [*Corymbia confertiflora* (F. Muell.) K.D. Hill & L.A.S. Johnson]

Broad-leaved carbeen is often a straggly tree to 15 m tall, branching at a quarter to half tree height, but occasionally taller. Although the crown is conspicuous for the broad leaves, this is a semi-deciduous tree and by the end of the dry season during September it may be nearly leafless. Flushes of new, reddish purple juvenile leaves appear during October. The crown may be comparatively small but its large leaves provide useful shade when the species is in full foliage.

This species is widely distributed and abundant for 2500 km across the tropics of northern Australia. It extends from the eastern Kimberley in Western Australia to the Townsville district in Queensland, and probably in the Port Moresby area of Papua New Guinea.

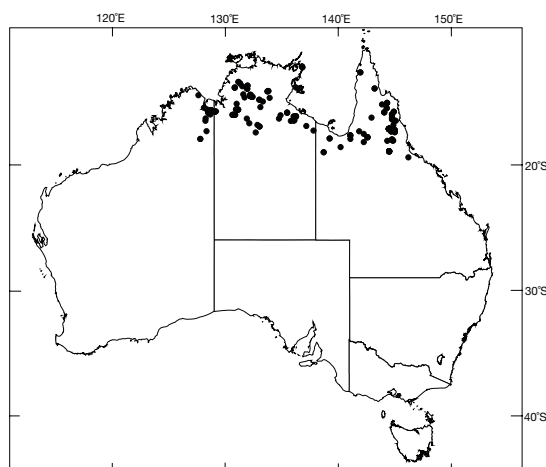
Broad-leaved carbeen occurs in narrow pure belts along stream banks, river levees or flats or on well-drained rolling topography of low relief. It grows on a wide range of soils from sandy loams to cracking clays. Substrates include granite, sandstone, laterite, metasedimentaries and limestone.

It is commonly dominant in low savannah woodlands or occurs as scattered trees in open woodlands. It may be associated with many other eucalypts including smooth-barked bloodwood (*E. foelscheana*), Darwin stringybark (*E. tetradonta*), Darwin box (*E. tectifica*), large-leaved cabbage gum (*E. grandifolia*), Wandii ironbark (*E. jensenii*), white gum (*E. platyphylla*) and Molloy red box (*E. leptophleba*). Other tree genera include *Erythrophleum*, *Lysiphyllum*, *Atalaya*, and *Petalostigma*.

Related species: Brooker (2000) placed broad-leaved carbeen in section *Abbreviatae*, a section defined by the shortened rachis of the inflorescence. This section comprises two series, one with rough bark (*Clavigerae*), and the other with smooth bark (*Scutiformes*). Broad-leaved carbeen belongs in the former series. In the *Abbreviatae*, the individual unit inflorescences have been reported as 7-flowered. The basal bark in the *Abbreviatae* is always rough and tessellated, although the whole trunk may be rough-barked. The other species in the group is apple gum (*E. polysiada*), which differs in the narrow leaves and in the past was confused with *E. clavigera*. It has a similar distribution to broad-leaved carbeen in the Northern Territory. Broad-leaved carbeen is closely related to several other species, which include *E. karelgica*, distributed to the west but still in the eastern Kimberley, and which differs by the much longer petioles of the adult leaves and the green new growth, and *E. disjuncta* which is distributed disjunctly through the wet monsoon tropics in the northern parts of all three northern States. It differs by the distinct petioles, longer pedicels and smaller fruits.

Publication: *Eucalyptus confertiflora*: J. Linn. Soc. Bot. 3, 96 (1859); *Corymbia confertiflora*: *Telopea* 6, 428 (1995). Type: West of Katherine, Northern Territory, 25 Oct. 1946, S.T. Blake 17300. This is a neotype as Mueller's specimen is apparently lost.

Names: Botanical—Latin *conferti* (crowded) and *flora* (flowers), referring to the inflorescences. Common—broad-



leaved refers to its large foliage and *carbeen* is the Aboriginal name of its close relative *E. tessellaris*.

Bark: Rough, tessellated on part or whole trunk, upper smooth bark white to silver grey.

Leaves: Seedling—opposite, sessile for 4–6 pairs, then alternate and shortly petiolate, elliptical to broad-lanceolate, 6–8 × 1.5–2.5 cm, setose, dull, light green, discolorous. Juvenile—opposite, shortly petiolate, broad-lanceolate to lanceolate, 7.5–10 × 2.5–4 cm, setose, dull, conspicuously purple or claret-coloured, discolorous. Intermediate—opposite, sessile to very shortly petiolate, orbicular to ovate, lanceolate, 12–25 × 8–18 cm, setose, dull green. Adult—opposite or subopposite, sessile to very shortly petiolate, ovate or elliptical to broad-lanceolate, 8–17 × 3–9 cm, setose, dull green.

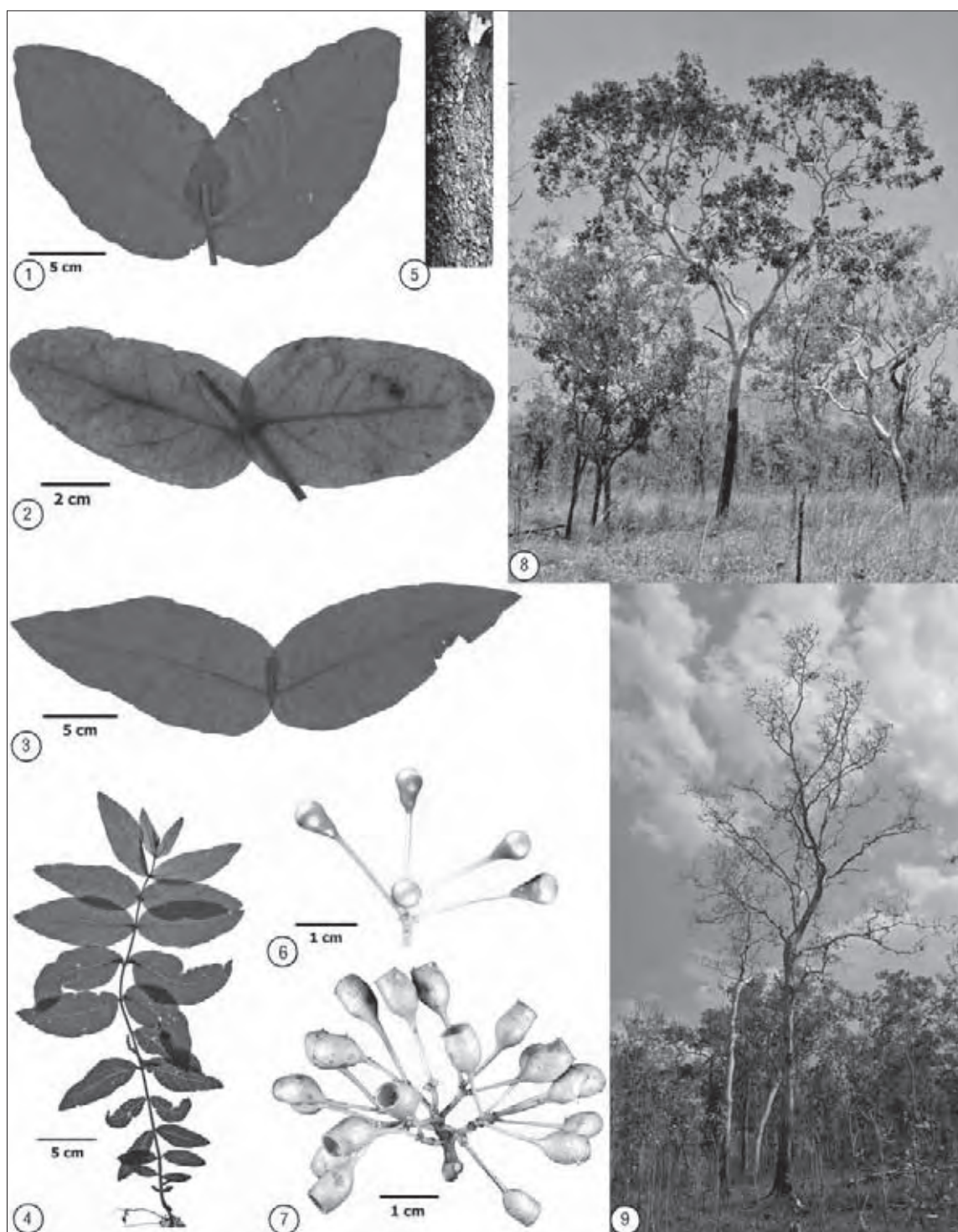
Inflorescences: Compound, in axils of leaves, whole inflorescences crowded, unit inflorescences about 7-flowered; peduncles 0.2–1.5 cm long; pedicels slender, 1.4–2.5 cm long; buds clavate to pyriform, 0.4–0.6 × 0.4–0.6 cm; opercula flattened-hemispherical. Flowers Jul.–Oct.

Fruits: On long pedicels, cupular, 1.1–1.5 × 0.9–1.2 cm, thin-walled; disc descending; valves deeply enclosed. Seeds circular, thin, red-brown, hilum ventral. Mature Nov.–Feb.

Wood: Sapwood pale, heartwood reddish brown or streaky reddish, brown to chocolate-brown, grain slightly to highly interlocked or wavy with intermediate texture and rather attractive figure on backsawn surfaces from parenchyma bands. Tough, very durable but not termite resistant; density about 915 kg m⁻³. In the past it has been recommended for use in tropical forestry and is suitable for amenity planting in its climatic area.

Climate: Altitudinal range: near sea level to 500 m; Hottest/coldest months: 33–36°C/13–14°C; Frost incidence: low; Rainfall: 650–1500 mm per year, summer max.

Distinctive features: Small to medium-sized tree with rough, tessellated bark on lower part or whole trunk; seasonally deciduous with new growth conspicuously purple or claret-coloured; unit inflorescences crowded; pedicels long, slender; thin-walled fruits that shed seeds shortly after ripening.



Eucalyptus confertiflora 1. Juvenile leaves 2. Coppice leaves 3. Adult leaves 4. Seedling 5. Bark 6. Buds 7. Fruits 8. Tree, with flush of new growth, Wenlock River, Qld 9. Tree, during dry season, Normanton, Qld

■ Bloodwoods (or Woody-fruited Bloodwoods)

Eucalyptus subgenus *Corymbia* (K.D. Hill & L.A.S. Johnson) Brooker (2000)

Corymbia section *Rufaria* K.D. Hill & L.A.S. Johnson (1995)

This group comprises about 70 species, mainly small trees, but ranging from shrubby forms to large forest trees well over 30 m in height. They are distributed over a wide range of environmental conditions. They are particularly plentiful in the northern half of Australia including the arid zone and to a lesser extent in south-western Western Australia where three species occur, and in the coastal strip on the eastern side of the continent where two species extend to far eastern Victoria. They have not spread to the coldest winter rainfall areas of south-eastern Australia. Most of Victoria and South Australia and all of Tasmania are devoid of bloodwoods.

Bloodwoods are often found in commercial eucalypt forests, frequently being more abundant on the drier and less favourable sites and commonly associated with jarrah, ironbarks, stringybarks, grey gums, red mahoganies and scribbly gums. The soils on these poor, often stony or sandy sites, contrast strikingly with those found beneath higher quality eucalypt forests and rainforests.

Generally speaking, bloodwoods are of low commercial value because of their relatively small size and the prevalence of kino (gum) veins and pockets in their timbers. The name 'bloodwood' is derived from this last characteristic, the kino being red and often oozing from lesions in the bark. In the round and when split or hewn into large sizes, the timber of some bloodwoods is used for heavy constructional work and as posts, poles, railway sleepers and piles. One of the bloodwood group, spotted gum (*E. maculata*), yields a timber particularly suited for tool handles, telephone insulator pins and meat skewers as well as being milled for general purposes such as weatherboards, flooring, boat building and railway sleepers. Another closely related species,

lemon-scented gum (*E. citriodora* subsp. *citriodora*), is notable for the presence in its leaves of citronellal, a valuable essential oil used in the manufacture of perfume.

Botanically the bloodwoods are divided into several groups basically on seed characters—a southern group (section *Notiales*) in which the seeds are wingless (although the wing-seeded red-flowering gum (*E. ficifolia*) endemic to the southern coast of Western Australia has been opportunistically included), a widespread group with winged seeds (subsection *Alatae*), and an eastern group in which the seeds are relatively small, wingless, saucer-shaped, ovoid or boat-shaped (subsection *Apterae*).

All species of *Notiales* and most *Alatae* species have tessellated bark, though the amount of rough bark varies; in some species the rough bark extends high onto the limbs as in pink bloodwood (*E. intermedia*) or the smaller branches may be smooth as in red bloodwood (*E. gummifera*).

In a few species, e.g. forms of *E. dichromophloia*, the bark is wholly white and smooth, although the latent tendency in the bloodwoods for producing tessellated bark may be evident after fire.

Bark in subsection *Apterae* is distinctly different. The subsection consists of several series—most notably series *Naviculares* (the yellow bloodwoods) in which the retained bark is persistent to the small limbs and is yellowish, somewhat flaky and not regularly tessellated, series *Torellianae* which has some basal tessellated bark and green, smooth bark above; and series *Maculatae* (spotted gum and lemon-scented gum) which are wholly smooth-barked, although mottling due to the seasonal flaking off of dead bark is often conspicuous.

Bloodwood seedlings usually have hairs on the leaves and stems, and the juvenile leaves are peltate in many species. The adult leaves are discolorous for many species (*Notiales*, and series *Dorsiventrals*), concolorous in others (series *Isobilaterals*), and have numerous, fine, wide-angled side veins, and a high degree of reticulation. While most eucalypts have a distinct intramarginal vein, in desert bloodwoods (e.g. *E. terminalis*), the side veins run direct to the

margin and the intramarginal vein is probably included in the marginal collenchyma.

The inflorescences for most species are large terminal panicles. This results in the flowers being conspicuous on the outside of the canopies as is so noticeable in the handsome red-flowering gum (*E. ficifolia*) of Western Australia, and the cream-flowering red bloodwood (*E. gummifera*) of eastern Australia. Spotted gum and lemon-scented gum are exceptions in that the inflorescences are compound, but form in the axils of the upper leaves and are not terminal to the shoots.

Buds in all bloodwood species are usually clavate (club-shaped), but there is a distinction in the time of loss of the outer operculum, which is held to flowering in all but the yellow bloodwoods. In these species a median scar on the bud

can be seen due to the early loss of the outer operculum. The filaments of the stamens are strongly inflexed. The anthers are oblong, versatile and open by longitudinal slits. The fruits in all groups are woody and usually urceolate, though long-fruited bloodwood (*E. polycarpa*) fruits are elongated more or less without a neck, and those of sand-dune bloodwood (*E. chippendalei*), Clifton's bloodwood (*E. cliftoniana*) and cadaga (*E. torelliana*) are more or less globular. The seeds of most bloodwoods are winged at one end. Exceptions are the three southern species, *E. gummifera*, *E. calophylla* and *E. haematoxylon*, and the yellow bloodwoods and spotted gums whose seeds are wingless. The cotyledons in the seed have their blades folded around each other unlike the flattened blades of the ghost gums.



1. A natural stand of spotted gum (*E. maculata*) on the South Coast of New South Wales, which has some of the most scenically attractive forests of this species in Australia. 2. Some bloodwoods, such as lemon-scented gum (*Eucalyptus citriodora*) growing here in Guangxi Province, China, are cultivated overseas as amenity plants or for their wood products. 3. The hard, woody fruits of red-flowering gum (*E. ficifolia*). All bloodwoods have superficially similar urn-shaped fruit capsules.

Swamp Bloodwood Spring Bloodwood, Red Bloodwood

Eucalyptus ptychocarpa F. Muell. [*Corymbia ptychocarpa* (F. Muell.) K.D. Hill & L.A.S. Johnson]

Swamp bloodwood is typically a tree of only medium size, attaining heights up to 15 m and dbh up to 0.6 m. The trunk is usually less than half the tree height and the trees are often of poor form. The main branches leave the trunk at wide angles, while the branchlets are pendulous. The crown is often as wide as the tree is high. There are two subspecies, the typical and subsp. *apterycha*.

Subsp. *ptychocarpa* has a scattered distribution in the north of Australia from the northern parts of the Kimberley region of Western Australia to the Northern Territory, including Bathurst and Melville islands north of Darwin, southwards to Daly Waters and eastwards to Murray Spring and Edith Spring just inside the Queensland border. Populations in the South Alligator River region and Arnhem Land, Northern Territory that tend to have buds and fruits that lack the prominent ribs typical of this species are subsp. *apterycha*.

Swamp bloodwood is notably a species of damp sites and favours the vicinity of creeks, springs, the base of cliffs and other places where drainage run-on increases water availability. It appears to be more dependent upon moisture availability than soil type, which varies from sands to fine-textured grey clays.

Swamp bloodwood is not a common species and tends to occur in small, pure low woodland clumps. In coastal areas it may be associated with *Pandanus* or long-leaved paperbark (*Melaleuca leucadendra*). In the inland river and swamp occurrences it may be associated with long-fruited bloodwood (*E. polycarpa*), Darwin stringybark (*E. tetradonta*) and weeping box (*E. patellaris*).

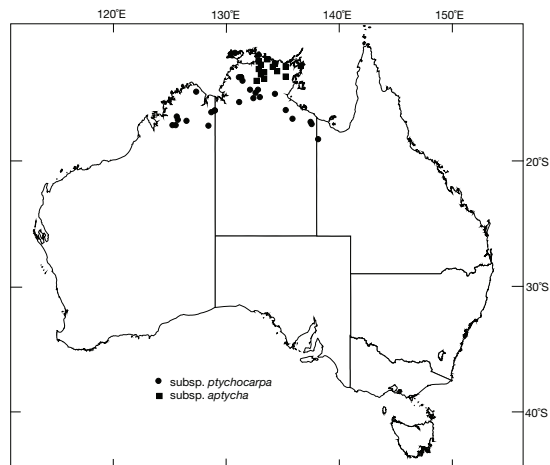
Related species: Brooker (2000) placed swamp bloodwood in the widespread section *Septentrionales* and in the large subsection *Alatae*, distinguished by the winged seeds. Within this subsection it is one of many species with discolourous adult leaves belonging to the series *Dorsiventrals*. Nearly all species in the series are of northern distribution. It is not closely related to any other species in the series. It is easily recognised by the large adult leaves, buds and fruits (strongly ribbed in subsp. *ptychocarpa*) and most conspicuously by the red, pink or apricot-coloured flowers, although rarely the colour may be white.

Publication: *Eucalyptus ptychocarpa*: J. Linn. Soc. Bot. 3, 90 (1859); *Corymbia ptychocarpa*: *Telopea* 6, 250 (1995). Type: 'Gulf of Carpentaria' (near Nutwood Downs, c. 100 km NE of Daly Waters, Northern Territory), 22 Jul. 1856, F. von Mueller. Subsp. *apterycha*: *Telopea* 6, 251 (1995). Type: Little Nourlangie Rock, 8 Dec. 1977, C.R. Dunlop 4655.

Names: Botanical—Greek *ptychos* (fold, cleft or groove), *carpos* (fruit), in reference to the ribbed fruits. Common—refers to the species preference for damp sites and to the bloodwood group of eucalypts.

Bark: Typical bloodwood type, persistent to the small branches, tessellated, grey-brown.

Leaves: Seedling—opposite, shortly petiolate, some peltate, ovate, 5–15 × 2–5 cm, dark green, strongly discolourous; stems, petioles and basal parts of midribs with short, reddish hairs.



Juvenile—opposite at first, later leaves alternate, petiolate, lower ones peltate, ovate to broad-lanceolate, 15–40 × 7–15 cm, dark green, strongly discolourous; with some hairs at first then becoming glabrous. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 28–45 × 7–15 cm, dark green, discolourous. Adult—alternate, petiolate, ovate to broad-lanceolate, 16–25 × 3.5–7 cm, dark green, discolourous.

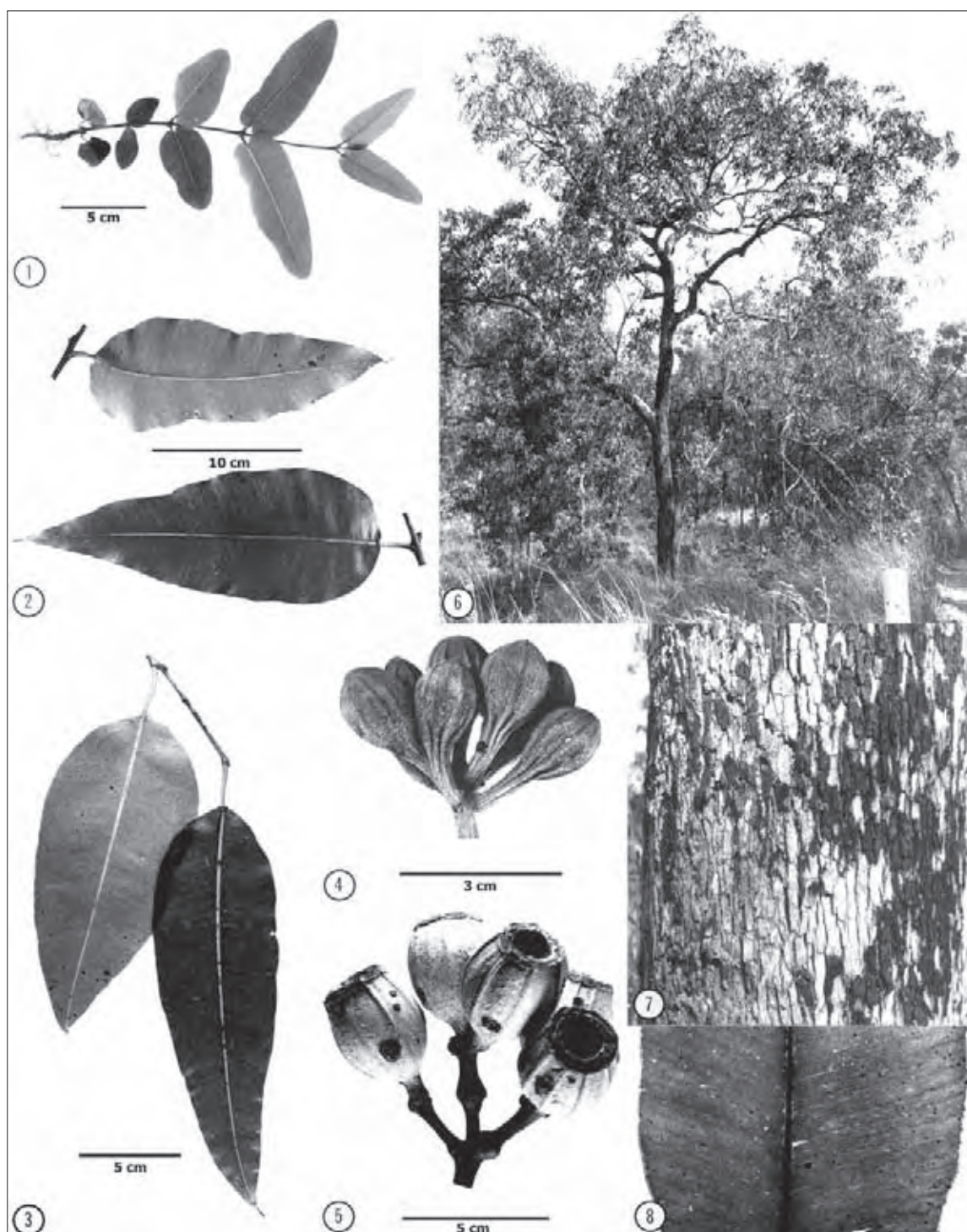
Inflorescences: Large, terminal panicles of 7-flowered unit inflorescences; peduncles terete, 1.5–5 cm long; pedicels 1.4–2.7 cm long; buds clavate or ovoid, 1.5–2.5 × 1.1–1.7 cm, ribbed (not or faintly ribbed in subsp. *apterycha*), pruinose or scurfy; opercula hemispherical; filaments white, pink, apricot or red. Flowers Sept.–Mar.

Fruits: Pedicellate, truncate-ovoid, 3.5–6 × 2–4 cm, woody, prominently ribbed (not or faintly ribbed in subsp. *apterycha*); disc broad, descending; valves 3, deeply enclosed. Seeds winged, red-brown, hilum subterminal, close to one edge.

Wood: Poorly known; populations are small and scattered and the wood rarely utilised.

Climate: Altitudinal range: near sea level to 500 m; Hottest/coldest months: 34–39°C/12–20°C; Frost incidence: low; Rainfall: 600–1500 mm per year, summer max.

Distinctive features: Persistent, tessellated, bloodwood-type bark; very large, discolourous leaves with very fine transverse venation; terminal panicles, unit inflorescences 7-flowered; flowers white, pink, apricot or red; large, ribbed buds and very large fruits that are strongly ribbed in subsp. *ptychocarpa*. Cultivated for its ornamental value.



Eucalyptus ptychocarpa 1. Seedling 2. Juvenile leaves 3. Adult leaves 4. Buds 5. Fruits 6. Tree, south of Adelaide River, N.T. 7. Bark 8. Adult leaf venation

Long-fruited Bloodwood and Clarkson's Bloodwood

Eucalyptus polycarpa F. Muell. [*Corymbia polycarpa* (F. Muell.) K.D. Hill & L.A.S. Johnson] and *Eucalyptus clarksoniana* D.J. Carr & S.G.M. Carr [*Corymbia clarksoniana* (D.J. Carr & S.G.M. Carr) K.D. Hill & L.A.S. Johnson]

These bloodwoods can be shapely, medium-sized trees up to 25 m in height, with moderately straight boles, half or more of the tree height and up to 0.7 m dbh. More generally they are smaller with open and rather straggling crowns, while the boles are short and of poor form.

Long-fruited bloodwood has a wide distribution across tropical northern Australia. It extends from Derby in the Kimberley region of Western Australia, across Northern Territory to near Georgetown and Mt Mulgrave in north Queensland. Possibly extends to the Edward River area on Cape York Peninsula. Clarkson's bloodwood is widely distributed in eastern Queensland from Cape York Peninsula south, extending to far northern New South Wales.

Both species occur mainly on undulating country, broad valleys and plains and the associated small ridges and hills. Occurrences of long-fruited bloodwood extend to river flats, beach-dune woodlands, the margins of swamps and seasonally swampy areas. Soils are usually sandy and may be of a coarse, skeletal nature, but as well show a wide range from hard grey clay on flats in monsoonal areas, to gravelly, sandy loams and deep sandy clays.

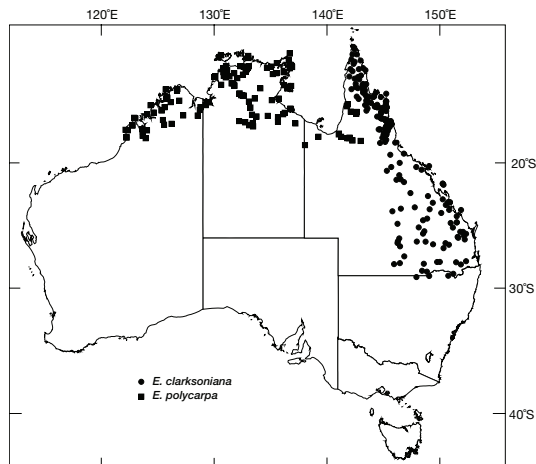
These bloodwoods occur in woodlands or open forests, associated with a wide range of other tree species. Commonly associated eucalypts include Darwin stringybark (*E. tetrodonta*), Darwin box (*E. tectifica*), carbeens (*E. bella*, *E. confertiflora*, *E. tessellaris*), white gum (*E. alba*, *E. platyphylla*), ghost gums (*E. aparrerinja*, *E. dallachiana*), ironbarks (*E. cullenii*, *E. crebra*, *E. melanophloia*), lemon-scented gum (*E. citriodora*) and forest red gum (*E. tereticornis*).

Related species: Brooker (2000) placed these two species in the widespread section *Septentrionales* and the large subsection *Alatae*, distinguished by the winged seeds. Within this subsection it is one of many species with discoloured adult leaves belonging to the series *Dorsiventrals*. These species are nearly all of northern distribution. In their revision of the bloodwoods Hill and Johnson (1995) described numerous taxa in this group and the reader is referred to this work to assess their relationships.

Publication: *Eucalyptus polycarpa*: J. Linn. Soc. Bot. 3, 88 (1859); *Corymbia polycarpa*: *Telopea* 6, 254 (1995). Type: 'Arnhem Land' (near Cox River, N. of Tanumibirini H.S., Northern Territory), 25 Jul. 1856, F. von Mueller. *Eucalyptus clarksoniana*: *Eucalyptus* 2, 209 (1987). *Corymbia clarksoniana*: *Telopea* 6, 259 (1995). Type: 7.6 km from Killarney, Qld, 15 Oct. 1980, Clarkson 3590.

Names: Botanical—Greek *poly* (many), *carpos* (fruit). Common—refers to the elongated fruits and to the bloodwood group of eucalypts. John Clarkson (b. 1950–) is a botanist based at Mareeba in north Queensland.

Bark: Typical bloodwood, persistent to the small branches, short-fibred, tessellated, grey-brown, soft.



Leaves: Seedling—opposite for 5 or 6 pairs, shortly petiolate, elliptical, 5–10 × 2.5–6 cm, green, discoloured. Juvenile—opposite then subopposite, shortly petiolate, elliptical to broad-lanceolate, 10–18 × 3.5–5 cm, green, discoloured. Stems, seedling leaves and early juvenile leaves have numerous hairs. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 15–20 × 4–5 cm, green, discoloured. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, sometimes broad-lanceolate, 10–18 × 1–3 cm, green, discoloured.

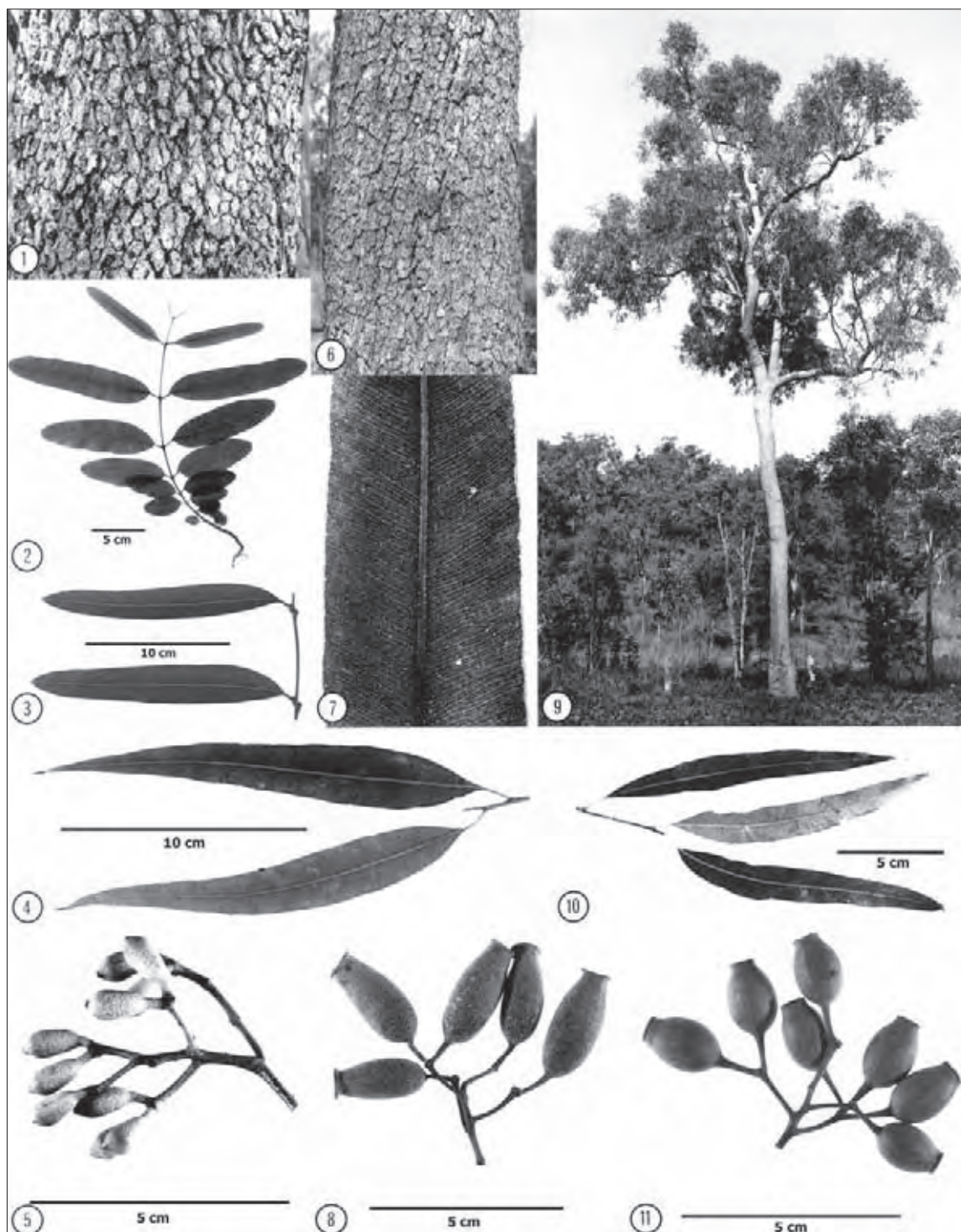
Inflorescences: Moderately large, terminal panicles, unit inflorescences 7-flowered; peduncles terete to slightly angled, 0.9–2 cm long; pedicels 0.2–0.9 cm long; buds ovoid to clavate, 0.7–1.4 × 0.4–0.8 cm, scurfy, usually pruinose; opercula hemispherical. Flowers Feb.–Jul.

Fruits: Pedicellate, urceolate, elongated, 1.7–3.2 × 1–1.8 cm (*polycarpa*) or non-elongated, up to 2 × 1.5 cm (*clarksoniana*), woody; disc broad, descending; valves 4, deeply enclosed. Seeds winged, red-brown, hilum subterminal, close to one edge.

Wood: Heartwood reddish, hard, strong, durable in the ground, grain wavy; density about 960 kg m⁻³; used in the round or split for posts, strainers and other farm timber and occasionally sawn for general construction; also a good fuel wood.

Climate: Altitudinal range: near sea level to 400 (–800) m; Hottest/coldest months: 32–38°C/5–20°C; Frost incidence: low to moderate (up to 20 each year at southernmost inland sites); Rainfall: 250–1750 mm per year, summer max.

Distinctive features: Tessellated, bloodwood-type bark to small limbs; all leaves discoloured; large terminal inflorescences; scurfy buds; elongated (*polycarpa*) or non-elongated (*clarksoniana*) woody fruits.



Eucalyptus clarksoniana (c), *Eucalyptus polycarpa* (p) 1, 6. Bark 2. Seedling 3. Juvenile leaves 4. Intermediate leaves 5. Buds 7. Adult leaf venation 8. Fruits (p) 11. Fruits (c) 9. Tree (p), south of Darwin, N.T. 10. Adult leaves

Pink Bloodwood Red Bloodwood

Eucalyptus intermedia R.T. Baker [*Corymbia intermedia* (R.T. Baker) K.D. Hill & L.A.S. Johnson]

Pink bloodwood is usually a medium-sized to tall tree 20–30 m in height and 1 m dbh, but may attain 40 m, with a long, straight trunk in excess of 1 m dbh. On poor sites height may be reduced to less than 20 m, with a short trunk of poor form. The crown is well developed and of moderate density.

Pink bloodwood extends for about 2500 km along the eastern coast of Australia from near Cape York in far northern Queensland to about 80 km north of Newcastle in New South Wales, and occurs mainly within 100 km of the sea. It is fairly common from northern coastal New South Wales as far north as Mackay in Queensland, and has disjunct occurrences from west of Townsville to Cooktown. Further north it is common in the high rainfall areas of eastern Cape York Peninsula, from Silver Plains east of Coen to the Jardine River catchment.

This species occurs largely on loams and clay loams. In the northern part of the distribution it grows on soils varying from coastal sand dunes to very coarse sandy soils and also on deep red loams of volcanic origin.

Pink bloodwood often occurs as one of the dominant species in open forests on poor coastal sites, either on flats or gentle slopes; less commonly it grows as scattered large specimens in closed forests, often bordering rainforest. The many associated eucalypts include broad-leaved stringybark (*E. caliginosa*), forest red gum (*E. tereticornis*), narrow-leaved red ironbark (*E. crebra*), carbeen (*E. tessellaris*), scribbly gum (*E. racemosa*), blackbutt (*E. pilularis*), grey gum (*E. propinqua*), flooded gum (*E. grandis*) and red mahogany (*E. resinifera*). Common associates in near coastal areas of northern Queensland are black sheoak (*Allocasuarina littoralis*) and red wattle (*Acacia flavescens*).

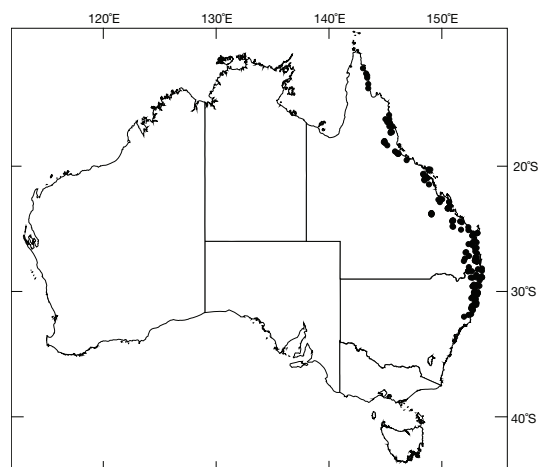
Related species: Brooker (2000) placed pink bloodwood in the widespread section *Septentrionales* and in the large subsection *Alatae*, distinguished by the winged seeds. Within this subsection it is one of many species, nearly all of northern distribution, with discoloured adult leaves belonging to the series *Dorsiventrals*. This species is most likely to be confused with red bloodwood (*E. gummifera*) with which it overlaps in New South Wales and southern Queensland. Pink bloodwood differs by the smaller, often speckled fruits compared with the more strongly urceolate, usually larger fruits of red bloodwood, which in addition has wingless seeds.

Publication: *Eucalyptus intermedia*: Proc. Linn. Soc. N.S.W. 25, 674 (1900); *Corymbia intermedia*: Telopea 6, 247 (1995). Type: Ballina, New South Wales, Jun. 1891, W. Baeuerlen.

Names: Botanical—Latin *intermedius* (intermediate), of the oils, which were reported as being intermediate in their chemistry between those of *E. gummifera* and *E. eximia*. Common—refers to the colour of the heartwood and to the bloodwood group of eucalypts.

Bark: Typical bloodwood-type, persistent to the smallest branches, short-fibred, friable and tessellated, light brown.

Leaves: Seedling—opposite for a few pairs, then subopposite, shortly petiolate, ovate to broad-lanceolate, 4.5–13 × 2–6 cm,



green, discoloured, setose. Juvenile—subopposite, becoming alternate, petiolate, broad-lanceolate, peltate in southern occurrences, apparently non-peltate in northern ones, 13–20 × 5–6 cm, green, discoloured, setose at first, later leaves becoming glabrous. Intermediate—alternate, petiolate, broad-lanceolate, 11–16 × 4–5 cm, green, discoloured. Adult—alternate, petiolate, broad-lanceolate to lanceolate, 9–16 × 1.5–3 cm, dark glossy green, discoloured.

Inflorescences: Large, terminal panicles, unit inflorescences 7-flowered; peduncles terete to slightly angular, 1–1.8 cm long; pedicels 0.2–1.4 cm long; buds ovoid, 0.8–1 × 0.4–0.6 cm, smooth (not scurfy); opercula conical. Flowers Jan.–Mar.

Fruits: Pedicellate, urceolate or ovoid, 1.1–2.1 × 0.8–1.6 cm, woody, surface commonly speckled with white dots; disc broad, descending; valves 4, deeply enclosed. Seeds winged, brown or red-brown, ellipsoidal, hilum ventral, close to one edge.

Wood: Sapwood susceptible to attack by *Lyctus* borers; heartwood deep pink to dark red-brown or yellow-brown, coarse-textured, hard, strong, durable, resistant to termites, kino (gum) veins prominent; density about 800–860 kg m⁻³; not often sawn but used in the round for fencing, mining timbers and heavy construction such as bridge work. Dust causes irritation to eyes and skin.

Climate: Altitudinal range: near sea level to 1200 m; Hottest/coldest months: 24–32°C/2–19°C; Frost incidence: low to moderate (at high elevation sites); Rainfall: 750–2200 mm per year, summer max.

Distinctive features: Tessellated, bloodwood-type bark to the small limbs; leaves at all stages discoloured; inflorescences of terminal panicles; usually urceolate, speckled fruits; winged seed.



Eucalyptus intermedia 1. Adult leaf venation 2. Buds (at point of flowering) 3. Seedling 4. Juvenile leaf 5. Bark 6. Fruits 7. Intermediate leaves 8. Tree, between Atherton and Herberton, Qld 9. Adult leaves

Red-flowering Gum Scarlet-flowering Gum

Eucalyptus ficifolia F. Muell. [*Corymbia ficifolia* (F. Muell.) K.D. Hill & L.A.S. Johnson]

Red-flowering gum is a small to medium-sized tree, usually of poor form, of coastal and subcoastal forests and woodlands. It attains up to 10 m in height with a bole up to 60 cm dbh, although on very poor sites with massive granite rock near the soil surface, it is reduced to a low spreading shrub. During summer to autumn it is conspicuous among associated species by the showy display of mainly red flowers.

This species has a very restricted distribution in the far south-west of Western Australia. The best-known occurrence is east of Walpole, although less accessible stands occur in the forest to the north-east of the town. There are two known disjunct occurrences: in the Stirling Range and the easternmost site is a very small stand on Boulder Hill east of Albany.

Some occurrences of red-flowering gum are on the fringes of swampy terrain, on poorly drained, grey sands. Other occurrences are on rises of gravelly sandy clay-derived laterite or among coastal sand dunes with outcropping laterite. At Boulder Hill it occurs on sandy loam on the mid-slopes of a granite rock outcrop.

Red-flowering gum forms low woodlands most commonly associated with open forests of marri (*E. calophylla*) and jarrah (*E. marginata*) with species such as banksias (*B. grandis*, *B. ilicifolia*) and casuarinas (*Allocasuarina* spp.) in the understorey. At Boulder Hill it is intermingled with Albany blackbutt (*E. staeri*), both being reduced to a 1.5 m tall shrub.

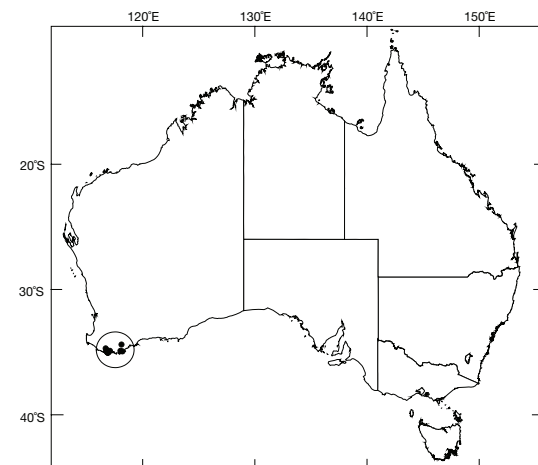
Related species: Brooker (2000) placed red-flowering gum in the predominantly southern section *Notiales*. Within the *Notiales* it is notable for winged seeds like those of the northern bloodwoods (section *Septentrionales*). Red-flowering gum is sometimes confused with marri (*E. calophylla*) as both have discolorous leaves, and large woody, urceolate fruits. The two are readily distinguished as marri is a taller tree, with tessellated bark (not tessellated in *E. ficifolia*), white flowers (rarely pink) and non-winged seeds. Without the flowers or seeds, red-flowering gum is distinguishable by the duller, thicker, leathery adult leaves and the lack of oil glands in the leaves. The other bloodwood species of the south-west is mountain marri (*E. haematoxylon*), which is a small tree or mallee restricted to the western side of the Darling Range, extending disjunctly northwards to the Mt Lesueur National Park. It has smaller fruit than red-flowering gum, is white-flowered and has non-winged seeds.

Publication: *Eucalyptus ficifolia*: *Fragm.* 2, 85 (1860); *Corymbia ficifolia*: *Telopea* 6, 245 (1995). Type: Broke Inlet, Western Australia, G. Maxwell.

Names: Botanical—from the Latin, *ficifolius* (fig-leaved), alluding to the similarity of the leaves. Common—refers to the flowers, although these may be red, pink or orange.

Bark: Rough, short-fibred, longitudinally fissured, extending to the small branches.

Leaves: Seedling and juvenile—petiolate, opposite for the first two nodes then alternate, broad-lanceolate, 6.5–14 × 3.5–6 cm, dull to slightly glossy green, strongly discolorous, stems with



short, rigid hairs. Adult—alternate, petiolate, broad-lanceolate, 7–14 × 2–6 cm, dull or slightly glossy, dark green above, slightly leathery, strongly discolorous.

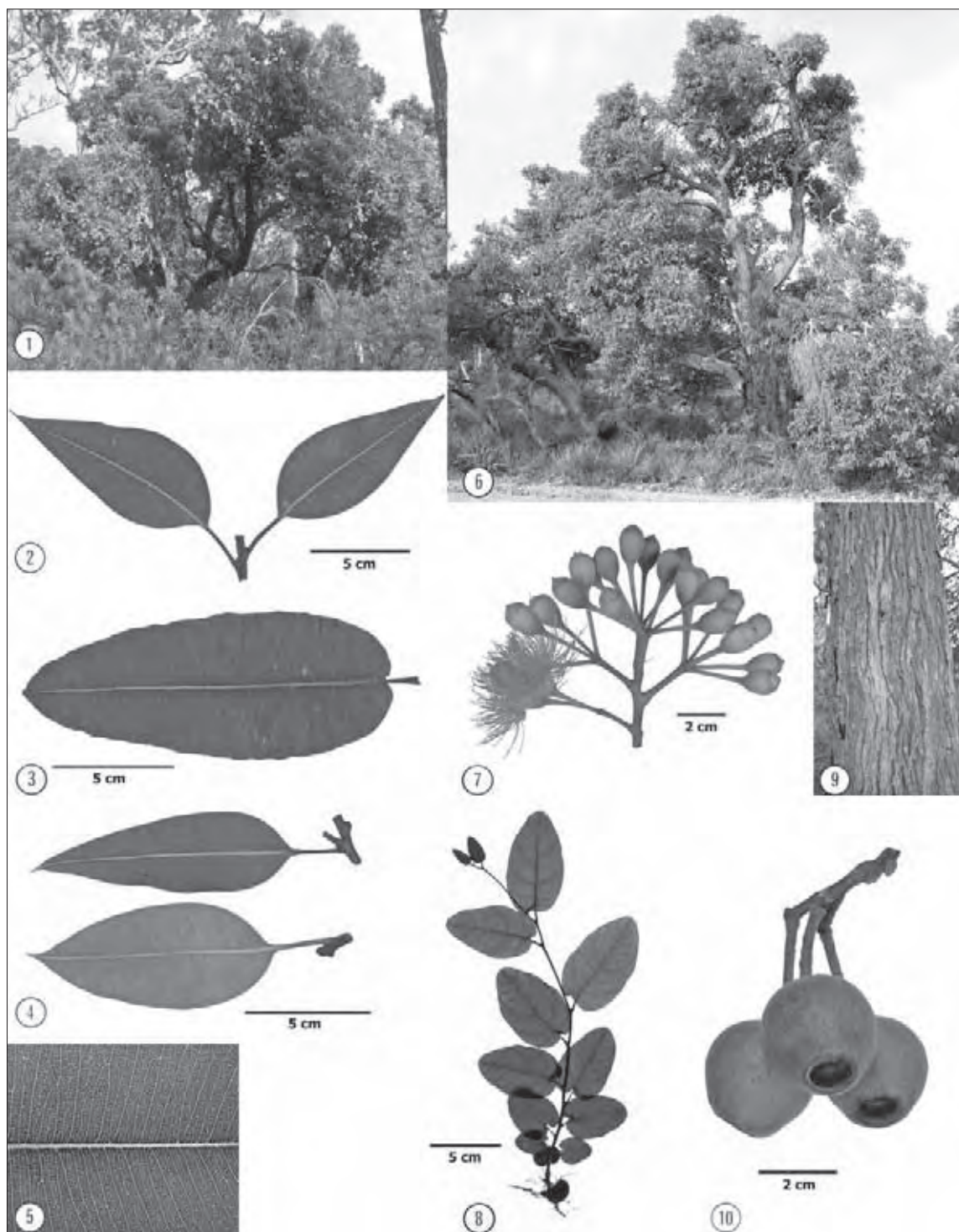
Inflorescences: Terminal panicles, unit inflorescences 7-flowered; peduncles terete or angular, 2–3.3 cm long; buds on long pedicels, ovoid to clavate, 1.2–1.6 × 0.6–0.8 cm, filaments brilliant red, pink or orange. Flowers Jan.–Apr.

Fruits: Pedicellate, barrel-shaped to slightly urceolate, 2–4.2 × 2–3.1 cm; disc broad, descending; valves 4 or 5, deeply enclosed. Seeds ellipsoidal with a terminal wing that extends along both edges, dark brown to black, hilum subterminal and close to one edge.

Wood: This species does not grow to utilisable timber size and its wood is not of economic value. Wood properties are poorly known other than it has the pale-coloured sapwood which is susceptible to *Lyctus* attack, and the heartwood is a rosy-red to red-brown colour, moderately fine-textured with an attractive figure on tangential and radial surfaces.

Climate: Altitudinal range: 20–160 m; Hottest/coldest months: 23–25°C/7–8°C; Frost incidence: low; Rainfall: 870–1300 mm per year, winter max.

Distinctive features: Small tree with rough, longitudinally fissured bark; adult leaves discolorous, lacking oil glands; terminal panicles of 7-budded unit inflorescences; long slender pedicels; brilliant pink, orange or red flowers; large woody fruits with winged seeds. Red-flowering gum is widely cultivated as an ornamental in temperate parts of Australia (and overseas) for its striking, showy flowers.



Eucalyptus ficifolia 1. Tree, near Walpole, W.A. 2. Adult leaves 3. Juvenile leaves 4. Adult leaves showing upper (top) and lower (bottom) leaf surfaces 5. Leaf venation 6. Tree, near Nornalup, W.A. 7. Buds close to anthesis 8. Seedling 9. Bark 10. Fruits

Marri Red Gum

Eucalyptus calophylla Lindl. [*Corymbia calophylla* (Lindl.) K.D. Hill & L.A.S. Johnson]

Marri is usually a medium-sized to tall tree up to 40 m in height and 1.5 m dbh, while exceptional specimens have been found to 60 m. The crown development varies with site, but under favourable conditions it is usually dense and heavily branched. The bole is commonly around half the tree height. On poor soils it is sometimes of mallee form.

Marri is widely distributed in the south-west of Western Australia and the major occurrence coincides with the main range of jarrah (*E. marginata*) and karri (*E. diversicolor*). It is abundant in the Darling Range and its main distribution extends from near Eneabba southwards to Cape Riche and eastwards to beyond Narrogin in the wheat belt. A northern outlier occurs near the Greenough River east of Geraldton.

Marri occurs on lateritic sandy gravels of the plateau of the Darling Range and extends west to the adjacent coastal plains to near sea level. While it will grow on comparatively poor soils its best development is generally found on the better sandy loam alluvium in the valleys between laterite-capped ridges. Marri soils are considered better for agriculture than those of typical jarrah sites.

This species occurs mainly in open forests, commonly associated with jarrah (*E. marginata*) and to a lesser extent in tall open forests associated with karri (*E. diversicolor*). Small pure stands occur south of the Blackwood River where it reaches its best development. On the drier side of its range, e.g. on the eastern remnants and slopes of the Darling Range it may occur with other eucalypts such as wandoo (*E. wandoo*), powderbark wandoo (*E. accedens*) and near moitch (*E. rudis*) in the gullies.

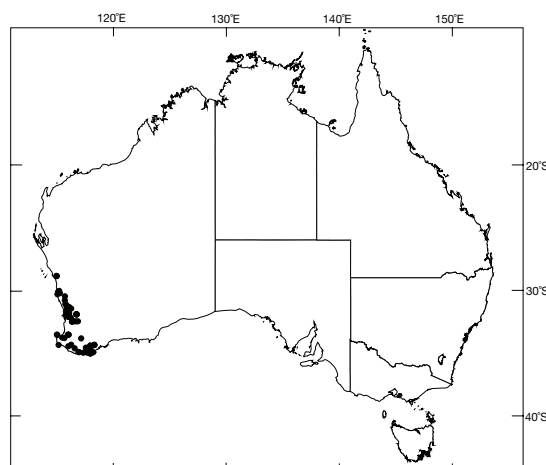
Related species: Brooker (2000) placed marri in the predominantly southern section *Notiales*, along with three other species. Within the *Notiales* it is notable for the unwinged seeds, a character it shares with mountain marri (*E. haematoxylon*), which is a tree of smaller stature with smaller fruits. Marri may be confused with red-flowering gum (*E. ficifolia*), which has restricted occurrences centred around the Walpole region. It is a smaller tree with non-tessellated bark, more leathery leaves that lack oil glands, normally bright red to orange flowers and smaller fruits with winged seeds.

Publication: *Eucalyptus calophylla*: Edward's Bot. Reg. 27, 72 (1841). *Corymbia calophylla*: *Telopea* 6, 240 (1995). Type: Princess Royal Harbour, Western Australia, 29 Dec. 1801, R. Brown.

Names: Botanical—Greek *calos* (beautiful), *phylon* (leaf). Common—of Aboriginal origin.

Bark: Typical bloodwood-type, persistent to the small branches, short-fibred, tessellated. In young trees the bark is grey in colour but with age it becomes brownish to dark grey, and is frequently stained in patches to a reddish hue by the kino, which exudes from the tree.

Leaves: Seedling—opposite for several pairs, then alternate, petiolate, peltate, ovate, 7–12 × 4–6 cm, hairy, green, strongly discolorous. Juvenile and intermediate—alternate, petiolate,



peltate, ovate, 12–20 × 6–8.5 cm, hairy, strongly discolorous. Adult—alternate, petiolate, ovate to broad-lanceolate, 9–14 × 2.5–4 cm, glossy, green, strongly discolorous, with oil glands.

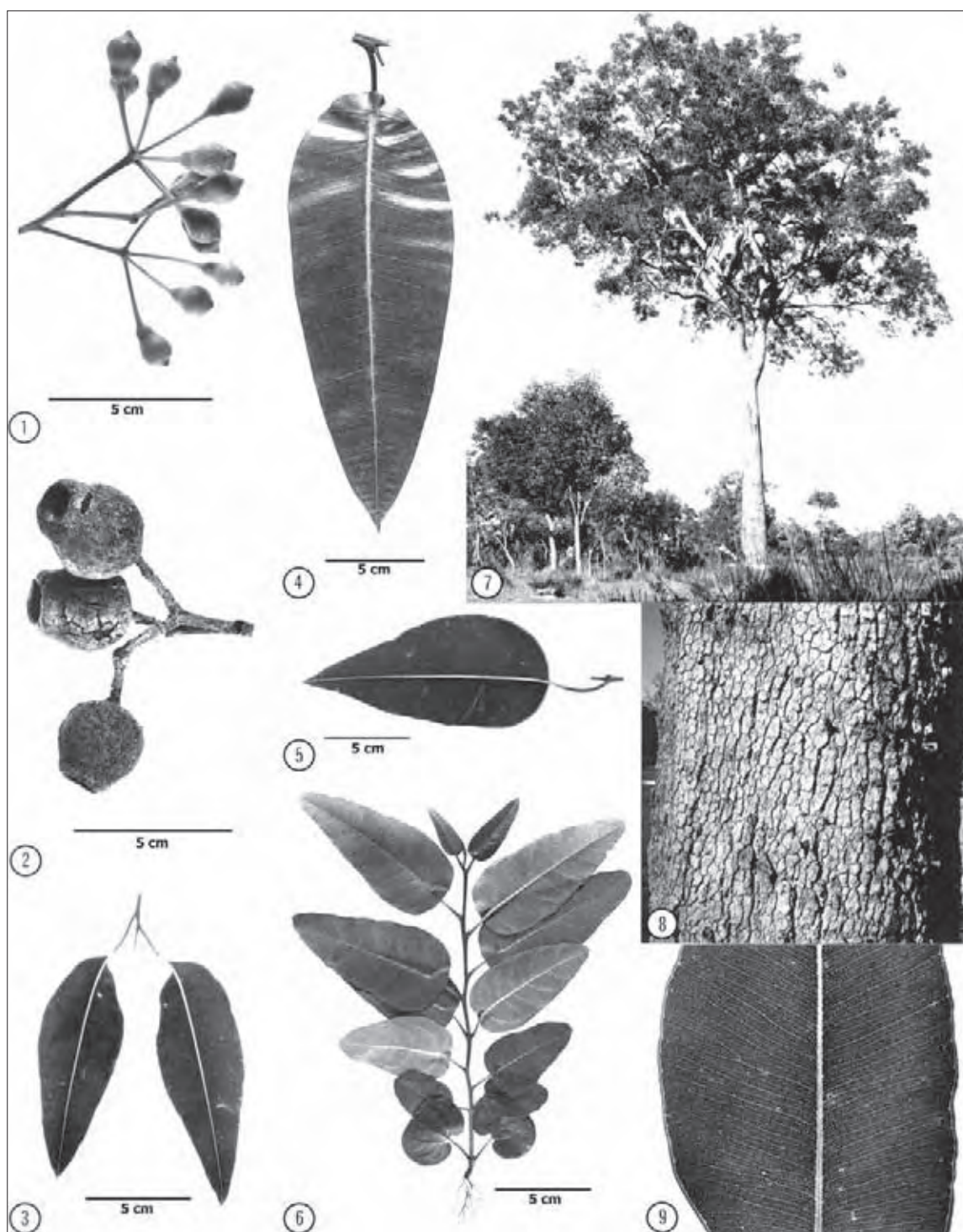
Inflorescences: Terminal panicles; unit inflorescences 7-flowered; peduncles terete to angular, 2.5–4.5 cm long; pedicels 2–4 cm long; buds clavate or pyriform to occasionally globular, 0.8–1.5 × 0.5–0.9 cm; opercula hemispherical; filaments generally cream but occasionally pink. Flowers Jan.–Mar.

Fruits: On long, stout pedicels, ovoid or more often urceolate with constriction below opening, 3–6 × 2.8–4 cm, thick and woody; disc broad, descending; valves 4, deeply enclosed. Seeds cymbiform (boat-shaped), black, wing absent, hilum ventral.

Wood: Sapwood susceptible to *Lyctus* borer attack; heartwood pale yellow to light brown usually with pink and grey tints, hard, strong, durable, non-fissile, moderately resistant to termites, easily worked but marred by kino (gum) veins; density about 590–1080 kgm⁻³; used for weatherboards, scantlings, case manufacture, tool handles, sporting goods, fence posts and jetty piles. Once a relatively non-commercial competitor in jarrah and karri forests, it has been a source of woodchips for pulp and paper production.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 24–30°C/4–8°C; Frost incidence: low (but up to 15 each year at inland sites); Rainfall: 650–1500 mm per year, winter max.

Distinctive features: Bloodwood-type bark, tessellated, thick; juvenile leaves hairy, peltate; adult leaves broad, strongly discolorous, with oil glands; inflorescences of large, 7-flowered, terminal panicles; pedicels to 4 cm long; flowers cream or rarely pink; fruits very large, woody, urceolate; the largest seed in the genus being up to 2 cm long, black, wingless, boat-shaped; very large cotyledons, up to 3 × 4.5 cm.



Eucalyptus calophylla 1. Buds 2. Fruits 3. Adult leaves 4. Juvenile leaf 5. Intermediate leaf 6. Seedling 7. Tree, between Pinjarra and Mandurah, W.A. 8. Bark 9. Adult leaf venation

Red Bloodwood

Eucalyptus gummifera Gaertner [*Corymbia gummifera* (Gaertner) K.D. Hill & L.A.S. Johnson]

Red bloodwood is usually a medium-sized to tall tree, 20–35 m in height and up to 1 m dbh, while exceptional specimens attain 60 m and more than 4 m dbh. On poor soils, where it frequently occurs, it is often reduced in size to less than 20 m tall and in some particularly harsh sites it occurs as a mallee. The trunk may be of poor form and only half the total height but may be up to two-thirds of the total height on good sites. The crowns of large trees are usually well developed and dense.

Red bloodwood occurs largely in coastal areas from the extreme eastern corner of Victoria northwards through eastern New South Wales into south-eastern Queensland as far north as Fraser Island, with disjunct inland occurrences in Mt Walsh National Park, Wondai State Forest, and north-east of Toowoomba.

This species occurs on a wide range of topography near the sea, though chiefly on flats and low hills. Best development is on moist, rich loams, but it is commonly found on poor sandy soils.

Red bloodwood generally grows in tall open or open forests. It may occur in almost pure stands on very poor or infertile heathlands near the sea, but on better sites it is found in association with many other eucalypts including grey gum (*E. punctata*), stringybarks (*E. agglomerata* and *E. capitellata*), blackbutt (*E. pilularis*), silvertop ash (*E. sieberi*), Sydney peppermint (*E. piperita*) and scribbly gum (*E. racemosa*).

Related species: Brooker (2000) placed red bloodwood in the predominantly southern section *Notiales* along with three other species. Within the *Notiales* it is notable for the wingless seed, a character it shares with the two southern Western Australian species, marri (*E. calophylla*) and mountain marri (*E. haematoxylon*). In its natural distribution, it can only be confused with pink bloodwood (*E. intermedia*), with which it overlaps and whose distribution extends much further north to Cape York and differs by the smaller, often speckled fruits and the wingless seeds.

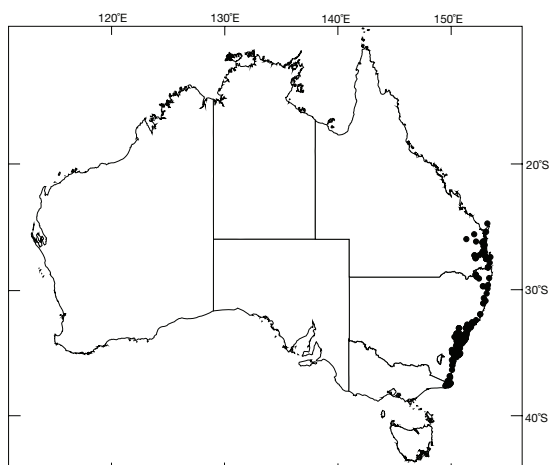
Publication: *Eucalyptus gummifera* (Gaertn.) Hochr., in *Candollea* 2, 464 (1925); *Corymbia calophylla*: *Telopea* 6, 233 (1995). Type: Botany Bay, 1770, J. Banks and D. Solander.

Names: Botanical—Latin *gummi* (gum), *fera* (bearing, carrying), referring to kino exudations. Common—refers to the colour of the heartwood and to the bloodwood group of eucalypts.

Bark: Typical bloodwood-type, persistent to the small branches, short-fibred and friable, tessellated and flaky, brown.

Leaves: Seedling—opposite for a few pairs, petiolate, elliptical to broad-lanceolate, a few pairs peltate, 4–12.5 × 1.5–4.5 cm, green, discolorous; stem and leaves hairy. Juvenile—alternate, petiolate, ovate to broad-lanceolate, 14–23 × 4.5–7.5 cm, green, discolorous. Intermediate—alternate, petiolate, broad-lanceolate, 11–16 × 3.5–4.5 cm, green, discolorous. Adult—alternate, petiolate, lanceolate or broad-lanceolate, 10–14 × 2–3.5 cm, glossy, dark green, discolorous.

Inflorescences: Terminal panicles; unit inflorescences 7-flowered; peduncles more or less terete to distinctly angular,



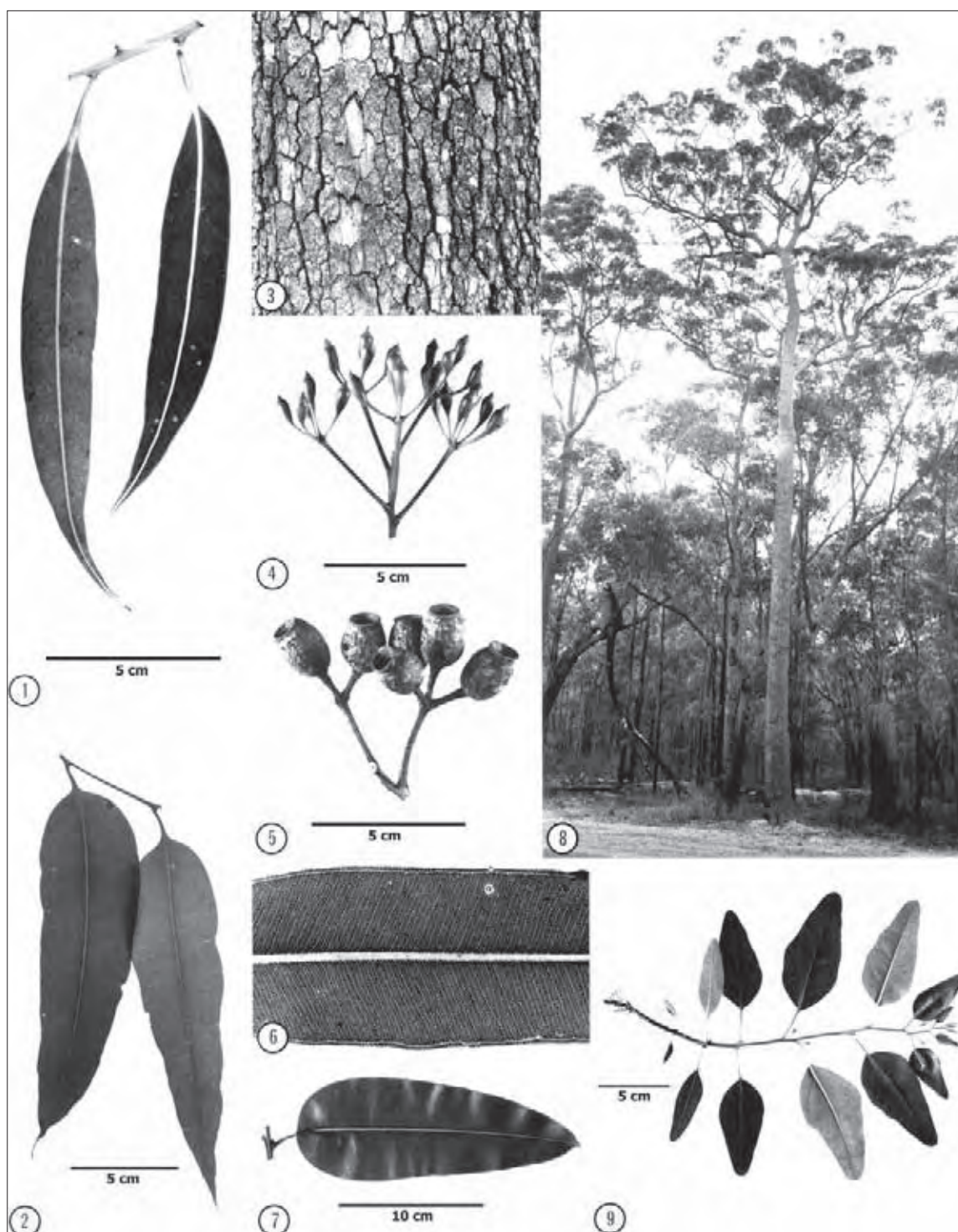
1.7–3 cm long; pedicels 0.9–1.4 cm long; buds clavate, 1–1.1 × 0.5–0.7 cm; opercula hemispherical, conical or beaked. Flowers Jan.–Apr.

Fruits: Pedicellate, urceolate, 1.5–2 × 1.1–1.4 cm; disc broad, descending; valves 3 or 4, deeply enclosed. Seeds cymbiform (boat-shaped), brown or red-brown, wing absent but with narrow marginal flange, hilum ventral.

Wood: Sapwood pale pink, susceptible to attack by *Lyctus* borers; heartwood dark pink to deep red, concentric bands of kino (gum) veins often large and extensive, very coarse-textured, grain generally interlocked, strong, extremely durable; density about 740–1005 kg m⁻³; has been used for poles, railway sleepers, mining timbers, fencing, hardboard manufacture.

Climate: Altitudinal range: near sea level to 300 (–800) m; Hottest/coldest months: 24–32°C/1–8°C; Frost incidence: low to moderate (up to 30 each year at inland and high elevation sites); Rainfall: 700–1800 mm per year, uniform to summer max.

Distinctive features: Typical tessellated bloodwood-type bark; leaves discolorous at all stages; inflorescences of conspicuous, large, terminal panicles; fruits urceolate; seed wingless.



Eucalyptus gummiifera 1. Adult leaves 2. Intermediate leaves 3. Bark 4. Buds 5. Fruits 6. Adult leaf venation 7. Juvenile leaf 8. Tree, south of Ulladulla, N.S.W. 9. Seedling

Smooth-stemmed Bloodwood

Eucalyptus bleeseri Blakely [*Corymbia bleeseri* (Blakely) K.D. Hill & L.A.S. Johnson]

Smooth-stemmed bloodwood is a tree up to 15–20 m tall and dbh to 0.6 m. At its best the trunk is straight and one-third to half the tree height before it divides or branches heavily to form the framework of a moderately large but somewhat open crown.

Smooth-stemmed bloodwood occurs mainly in the higher rainfall region of the Northern Territory around Darwin, as well as on Bathurst and Melville Islands. It extends southwards to the somewhat drier areas of Katherine and Mataranka and occurs also in the Kimberley region of northern Western Australia.

This species grows on the higher and better-drained flats that are not inundated during the monsoonal rains, and also on gentle slopes and on comparatively low plateaux such as those near Pine Creek and Maranboy. The soils are mainly sandy, sandstone skeletal or laterites, with the better growth on the deeper soils with strongly differentiated profiles.

Smooth-stemmed bloodwood usually grows as scattered or moderately abundant trees in open forests or woodlands, commonly in association with eucalypts such as Darwin stringybark (*E. tetradonta*) and Darwin woollybutt (*E. miniata*).

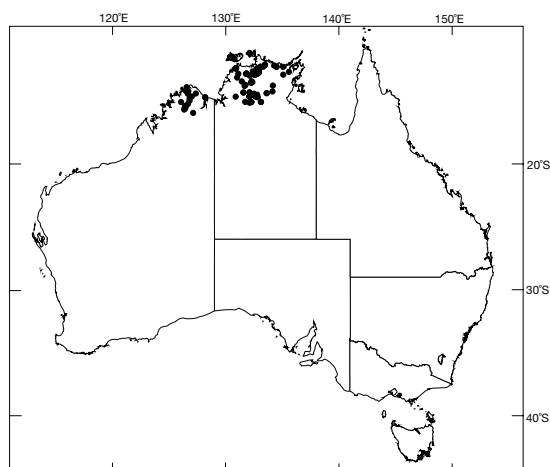
Related species: Brooker (2000) placed smooth-stemmed bloodwood in section *Septentrionales*. This is a largely northern, eastern and centrally distributed section characterised by species with winged seeds. Most bloodwoods have peltate juvenile leaves and these are particularly conspicuous in smooth-stemmed bloodwood. It is also notable for the rough bark at the base and the more sparsely flaky rough bark over the upper trunk, the bright green, shiny leaves and conical (not hemispherical) opercula. It is closely related to silver-leaved bloodwood (*E. collina*) of the central Kimberley, which differs in the silvery new growth and larger buds and fruits. Both species are distinguished by the long pedicels.

Publication: *Eucalyptus bleeseri*: J. Proc. Roy. Soc. N.S.W. 61, 175 (1927); *Corymbia bleeseri*: Telopea 6, 288 (1995). Type: Near Darwin, Northern Territory, Feb. 1927, D.W.C. Shires and F.A.K. Bleeser.

Names: Botanical—after F.A.K. Bleeser (1871–1942) the collector of the type, who was Assistant Postmaster in Darwin and a keen amateur botanical collector. Common—refers to the upper bark and to the bloodwood group of eucalypts.

Bark: Lower 2–3 m retained as thin, yellow, grey or orange flakes forming a distinct stocking, but shed above leaving a smooth yellowish white surface over most of the upper trunk and all the branches.

Leaves: Seedling—opposite, shortly petiolate, elliptical to ovate, becoming cordate, peltate, 3–12 × 1.5–5 cm, pale green, concolorous or slightly discolorous. Juvenile—opposite, becoming alternate, petiolate, ovate, cordate, peltate, 10–18 × 5–7 cm, pale green, concolorous or slightly discolorous; both sides of the leaves and the stems of the young plant are covered with hairs. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 15–18 × 2–6 cm,



glossy green, slightly discolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 12–17 × 1.2–2 cm, glossy green, slightly discolorous.

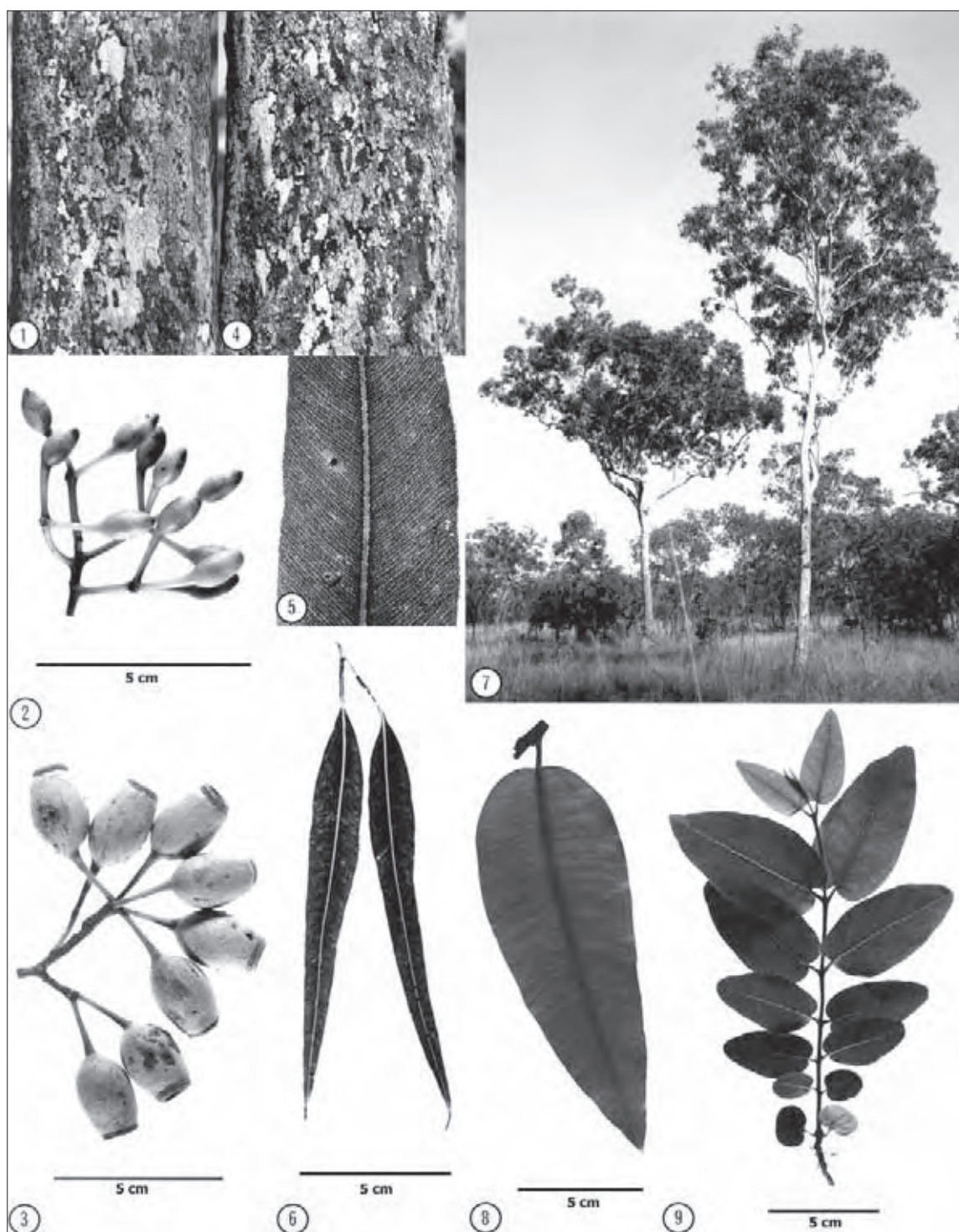
Inflorescences: Terminal panicles, unit inflorescences 7-flowered; peduncles terete, 1.2–3 cm long; pedicels 1–2 cm long; buds ovoid, 1–1.3 × 0.6–0.9 cm; opercula obtusely conical. Flowers Dec.–May.

Fruits: On long pedicels, oblong-ovoid, cylindrical or sometimes slightly urceolate, woody, 1.3–2.7 × 1–1.7 cm; disc broad, descending; valves 4, deeply enclosed. Seeds ellipsoidal with a terminal wing, red-brown, hilum subterminal, close to one edge.

Wood: Sapwood white, about 2.5 cm thick; heartwood dark red-brown, hard and tough, moderately durable and resistant to termite attack; few trees are suitable for sawmilling due to form, size and internal defect.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 34–38°C/10–20°C; Frost incidence: low; Rainfall: 650–1500 mm per year, summer max.

Distinctive features: A partly rough-barked tree with a basal stocking of yellow, grey or orange flakes, smooth, yellowish white above, or sparsely flaky above; juvenile leaves conspicuously peltate; adult leaves glossy green; pedicels long; opercula obtusely conical; inflorescences terminal panicles.



Eucalyptus bleeseri 1, 4. Bark 2. Buds 3. Fruits 5. Adult leaf venation 6. Adult leaves 7. Trees, south of Katherine, N.T. 8. Juvenile leaf 9. Seedling

Melville Island Bloodwood

Eucalyptus nesophila Blakely [*Corymbia nesophila* (Blakely) K.D. Hill & L.A.S. Johnson]

Melville Island bloodwood is a medium-sized to tall forest tree up to 30 m in height and 1 m dbh. The trunk is usually unbranched for half to two-thirds of the tree height when it divides into a moderately dense, fine-leaved canopy.

Melville Island bloodwood occurs in the north-western Kimberley region of Western Australia and Cape York Peninsula in Queensland, and in the Northern Territory it is restricted to Melville and Bathurst Islands and Cobourg Peninsula.

In the island and Cobourg Peninsula occurrences, this species prefers flats and lower slopes and does not extend to the higher slopes or ridge tops. Best growth is on moderately good sandy loams but it will grow on most sandy soils, avoiding heavy alluvial soils or poorly drained sites. In the Kimberley region it is found on the Mitchell Plateau on laterite-capped hills. In Cape York Peninsula it also grows mainly on laterite deposits of low relief.

The main occurrence of this species is in open forests usually associated with Darwin woollybutt (*E. miniata*) and Darwin stringybark (*E. tetrodonta*) and on Cobourg Peninsula with cypress pine (*Callitris columellaris*). In the Kimberley region it is found with *E. miniata*, *E. tetrodonta* and round-leaved bloodwood (*E. latifolia*). In Cape York Peninsula it is often associated with carbeen (*E. tessellaris*), Molloy red box (*E. leptophleba*), Clarkson's bloodwood (*E. clarksoniana*) and Cooktown ironwood (*Erythrophloeum chlorostachys*). On particularly favourable sites it may be occasionally found in small pure stands or as the dominant species in small areas.

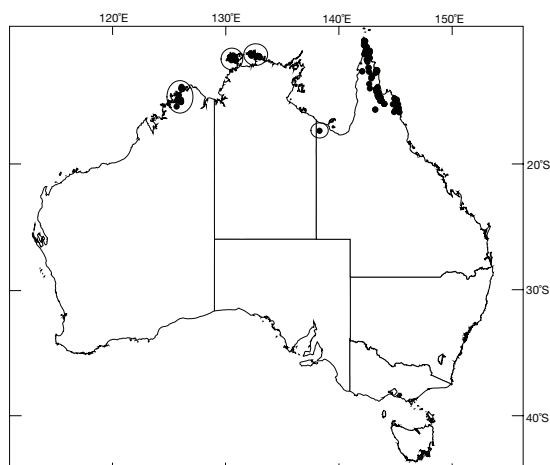
Related species: Brooker (2000) placed Melville Island bloodwood among many species of the largely northern, eastern and central section *Septentrionales* and in the large winged-seeded subsection *Alatae*. Within this subsection it forms part of the series *Peltiformes* with two other species (*E. bleeseri* and *E. collina*), but is not particularly close in appearance or morphology to either of these species.

Publication: *Eucalyptus nesophila*: Key to *Eucalypts*, 90 (1934); *Corymbia nesophila*: *Telopea* 6, 242 (1995). Type: Bathurst Island, Northern Territory, 1920, G.F. Hill 465.

Names: Botanical—Greek *nesos* (island), *philos* (loving), a reference to the type area. Common—after one of the islands on which the species is very common, and after the bloodwood group of eucalypts. The common name is not appropriate, but reflects its first recognition in the islands north of Darwin.

Bark: Typical bloodwood-type, persistent to the small branches, short-fibred, distinctly tessellated, outer bark light grey and inner bark orange to red.

Leaves: Seedling—opposite for several pairs, petiolate, peltate, first few narrow-lanceolate, then broad-lanceolate, 6–10 × 1–2.5 cm, green, discolorous, hairy. Juvenile—alternate, petiolate, some peltate, broad-lanceolate to ovate, often cordate, 10–14 × 3–8 cm, green, discolorous, hairy. Intermediate—alternate, broad-lanceolate to lanceolate, 16–19 × 2.5–4.5 cm, green, slightly discolorous, the blade of the leaf smooth and glossy but the internodes very hairy.



Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 8–18 × 0.9–1.8 cm, glossy green, slightly discolorous.

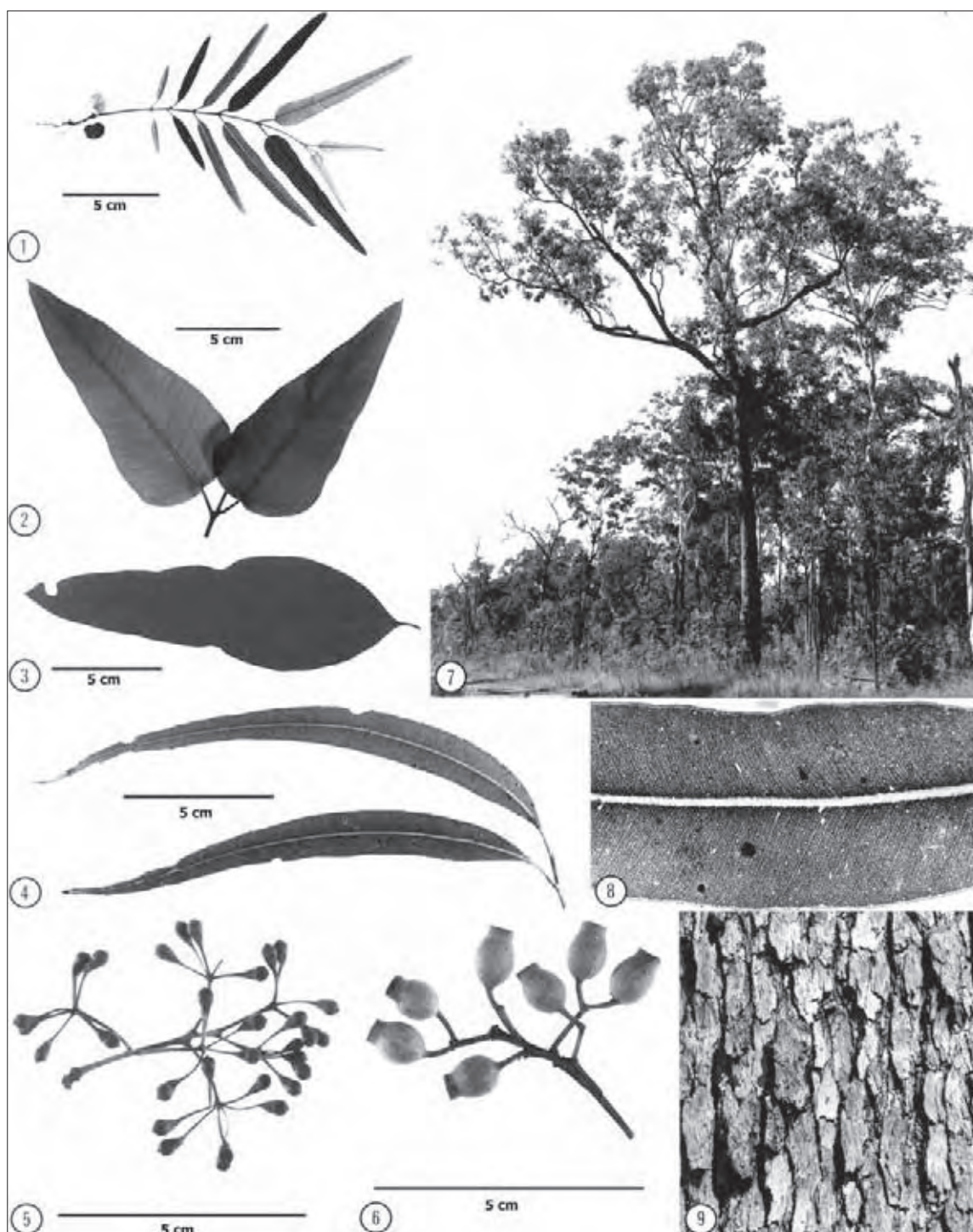
Inflorescences: Terminal panicles, unit inflorescences 7-flowered; peduncles terete or slightly angled, 1–1.6 cm long; pedicels 0.3–1 cm long; buds clavate, 0.4–0.7 × 0.3–0.5 cm; opercula hemispherical-apiculate. Flowers Jun.–Aug.

Fruits: Pedicellate, ovoid or urceolate, 0.9–1.5 × 0.7–0.9 cm; disc broad, descending; valves 3 or 4, deeply enclosed. Seeds ellipsoidal with a terminal wing, red-brown, hilum subterminal, close to one edge.

Wood: Sapwood white, about 2.5 cm thick; heartwood reddish brown, coarse-textured with interlocked grain, moderately hard, durable, moderately termite resistant; frequent kino (gum) veins, density in the range of 905–1010 kg m⁻³; used locally for poles and piles, and occasionally sawn for construction purposes, and also for railway sleepers in the Weipa area.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 31–38°C/13–22°C; Frost incidence: low; Rainfall: 1000–1750 mm per year, summer max.

Distinctive features: Bloodwood-type bark, tessellated grey outer, orange-red inner bark to small limbs; juvenile leaves peltate; bright green, glossy, slightly discolorous adult leaves; buds non-scurfy; fruits longer than wide, often urceolate.



Eucalyptus nesophila 1. Seedling 2. Juvenile leaves 3. Intermediate leaf 4. Adult leaves 5. Buds 6. Fruits 7. Tree, near Pickertaramoor, Melville Island, N.T. 8. Adult leaf venation 9. Bark

Red Bloodwood Gum-topped Bloodwood

Eucalyptus erythrophloia Blakely [*Corymbia erythrophloia* (Blakely) K.D. Hill & L.A.S. Johnson]

Red bloodwood is a small to medium-sized tree up to 15 m tall with a spreading canopy. The bole often breaks into two main branches below the crown at about half tree height. The often exposed, red or reddish orange inner layer of rough bark gives this species its scientific and common names. Trees often occur in small isolated clumps suggesting vegetative origin from one or more parents.

Red bloodwood is widespread in Queensland, mainly west of the coastal ranges. It grows from south-west of Cooktown on Cape York Peninsula, near Walkamin, with the main distribution from Mt Garnet south to north-east of Kingaroy and inland to the Drummond Range and Alpha. It occurs near the coast from Bowen to south of Gladstone.

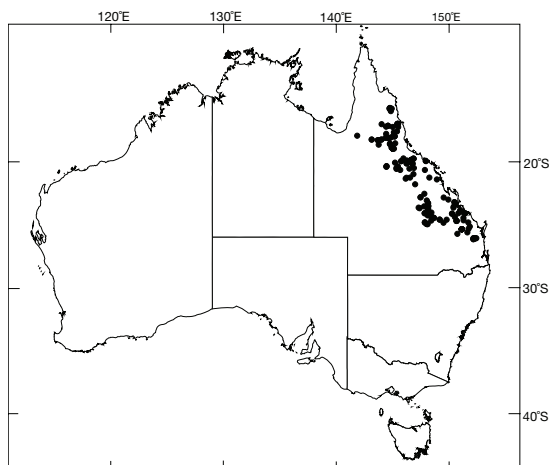
Red bloodwood grows on heavier soils on flats or low hills but also grows on steeper, rocky sandstone rises. Soils include clays or loams but are typically red and black clay soils, often over basalt.

This species occurs in open woodlands with a grassy understorey. Due to its small stature red bloodwood often forms a lower canopy in these woodlands. Associated species include ironbarks (*E. crebra*, *E. melanophloia*), mountain coolibah (*E. orgadophila*), carbeen (*E. tessellaris*), Gympie messmate (*E. cloeziana*), white gum (*E. platyphylla*) and other bloodwoods (*E. clarksoniana*, *E. leichhardtii*).

Related species: Brooker (2000) placed red bloodwood in the predominantly northern section *Septentrionales*. The *Septentrionales* divide into two large subsections based on the presence (subsection *Alatae*) or absence (subsection *Apterae*) of wings on the seeds. The winged-seeded group divides into three taxonomic series diagnosed by discoloured adult leaves (*Dorsiventrals*), concolorous leaves (*Isobilaterals*) and species with the crown composed of opposite juvenile leaves (*Terminalipterae*). Red bloodwood belongs with about a dozen species in the *Isobilaterals*, in a further subdivision which is characterised by having non- or scarcely peltate seedling and juvenile leaves, and relatively narrow adult leaves compared with a related group which includes *E. greeniana* and *E. latifolia*. Many of the species are desert or dry-country species. Red bloodwood is close to or conspecific with *E. pocillum*, which occurs west of the range of typical red bloodwood as far as Normanton south of the Gulf of Carpentaria, and close to or conspecific with *E. ellipsoidea* of the Atherton Tableland. Both these species have much less rough bark than red bloodwood, but other distinctions are slight. A closely related species, *E. dichromophloia*, also has less rough bark, which is not reddish, and smaller fruits.

Publication: *Eucalyptus erythrophloia*: Key *Eucalypts*: 80 (1934); *Corymbia erythrophloia*: *Telopea* 6, 304 (1995). Type: The old battery, Eidsvold, Sep. 1919, T.L. Bancroft.

Names: Botanical—Greek *erythro* (red), *phloios* (bark)—refers to the freshly exposed bark colour, although it weathers to grey-brown. Common—refers to the colour of bark and to the bloodwood group of eucalypts.



Bark: Rough over whole trunk and larger branches, flaky, soft, tessellated, mottled grey-brown over reddish, orange or reddish brown; smooth greyish white or pinkish grey on the smaller branches. The red colour is most striking on newly exposed flakes of bark.

Leaves: Seedling—opposite, petiolate, lanceolate to broad-lanceolate, 5–11 × 1–3.5, glabrous, pale green, discoloured. Juvenile—opposite for few pairs then alternate, petiolate, broad-lanceolate to lanceolate, 9–14 × 3.5–4.5 cm, pale green, slightly discoloured. Intermediate—mostly alternate, petiolate, lanceolate, 13–18 × 2.5–3.5 cm, yellowish green, slightly discoloured or concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 9–18 × 1–2.5 cm, dull, green to light green, concolorous to slightly discoloured. Inland trees tend to have concolorous leaves while those closer to the coast are somewhat discoloured.

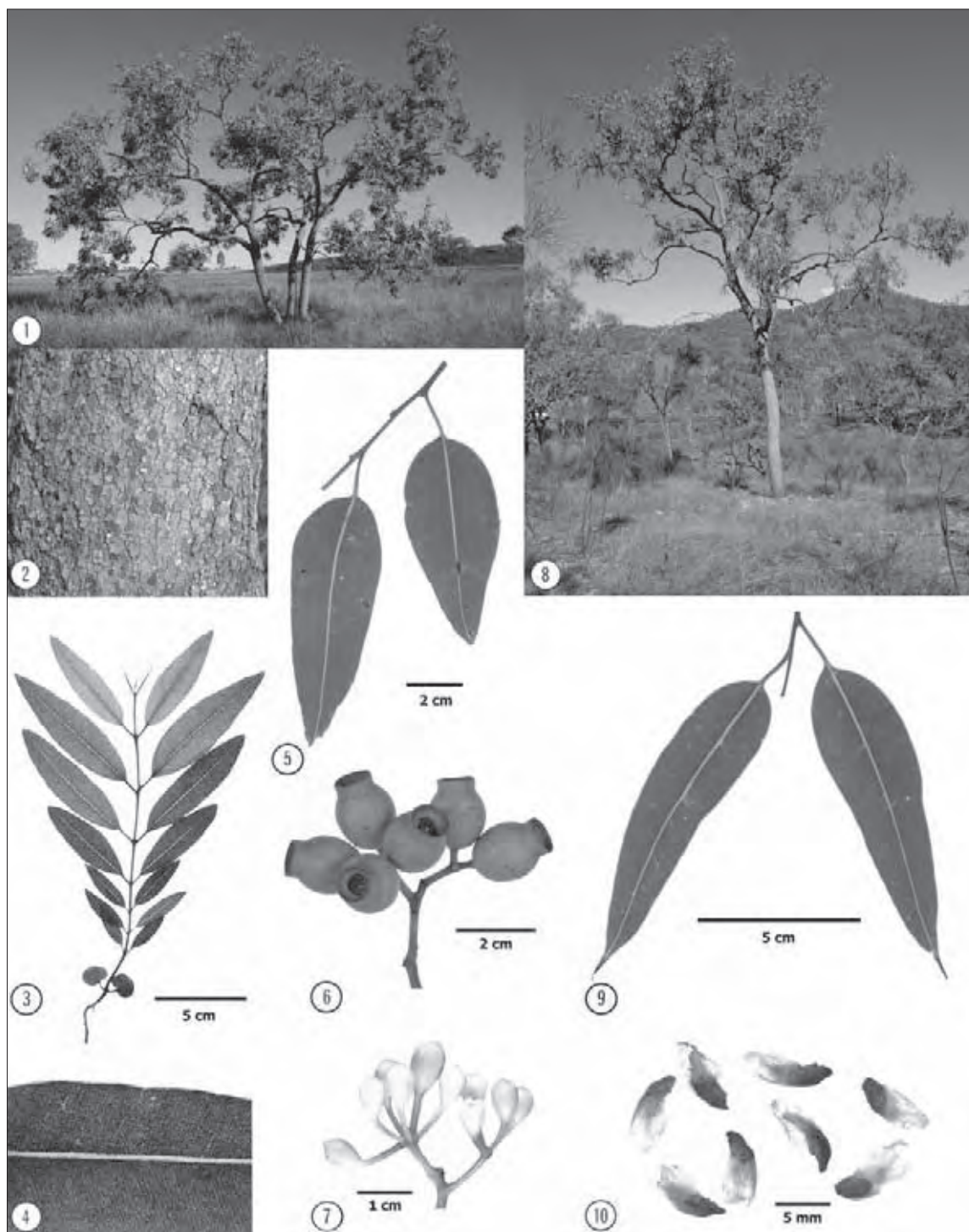
Inflorescences: Terminal panicles, unit inflorescences 7-flowered; peduncles slightly angular to distinctly flattened, 0.5–1.4 cm long; buds pedicellate, pedicels to 1 cm long, broadly clavate, pyriform to globular, 0.6–1 × 0.4–0.7 cm, pale green, not scurfy. Flowers Jan.–Apr.

Fruits: Pedicellate, urceolate, 1–2 × 0.9–1.5 cm; disc broad, descending; valves usually 4, deeply enclosed. Seeds elliptical, winged, red-brown, hilum subterminal, near to one edge. Mature Oct.–Dec.

Wood: Poorly known as this species does not grow to utilisable timber size; heartwood reddish brown and of fair quality, density 1040 kg m⁻³.

Climate: Altitudinal range: 50–1100 m; Hottest/coldest months: 31–32°C/9–10°C; Frost incidence: low; Rainfall: 700–1350 mm per year, summer max.

Distinctive features: Small tree with striking reddish inner bark when exposed by weathering; terminal, compound inflorescences of 7-budded unit inflorescences; urceolate woody fruits up to 2 cm long.



Eucalyptus erythrophloia 1. Tree, near Rolleston, Qld 2. Bark 3. Seedling 4. Adult leaf ventation 5. Juvenile leaves 6. Fruits 7. Buds 8. Tree, near Kilkivan, Qld 9. Adult leaves 10. Seeds

Tjuta Joolta, Desert Bloodwood, Inland Bloodwood, Pale Bloodwood

Eucalyptus terminalis F. Muell. [*Corymbia terminalis* (F. Muell.) K.D. Hill & L.A.S. Johnson]

Tjuta is a small to medium-sized tree or rarely a mallee. The bole is typically short, less than half the tree height, and the crown is usually heavily branched. Largest specimens attain 15 m in height, but trees 6–10 m tall are more typical throughout its range. Flows of a dark red kino are often evident on the bark of tjuta, presumably produced as a response to injury. Large woody galls formed by gall-inducing coccoids are often evident in the crown of this species.

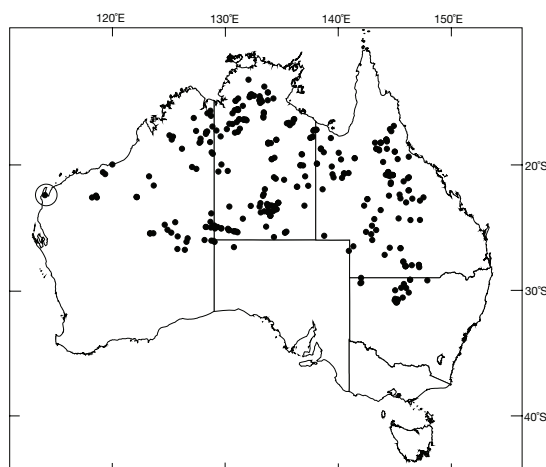
This species is widespread in northern Australia, extending to far north-western South Australia and to south of the Darling River in New South Wales. It occurs on the Exmouth Peninsula in Western Australia and is replaced by *E. hamersleyana* in the more elevated Pilbara region to the east; it is found in the southern Kimberley, over most of the Northern Territory apart from the wetter northern parts, and in Queensland it extends east to Almaden, north of Clermont and south to west of Roma.

Tjuta typically grows on river flats, scree slopes, in the swales of dune systems and on sand ridges. Soils are reddish sands or sandy loams derived from a range of substrates including aeolian and alluvial deposits, quartzite, granite, sandstone and calcrete.

Tjuta mainly occurs in low open woodlands, often in mulga (*Acacia aneura*) communities. Over its wide range it can be associated with a large number of species, including various eucalypts and especially species of *Acacia*, *Grevillea* and *Triodia*.

Related species: Brooker (2000) placed tjuta in the predominantly northern section *Septentrionales*. The *Septentrionales* divide into two large subsections based on the presence (subsection *Alatae*) or absence (subsection *Apterae*) of wings to the seeds. The winged-seeded group divides into three taxonomic series diagnosed by discoloured adult leaves (series *Dorsiventrals*), concolorous leaves (series *Isobilaterals*) and species with the crown composed of opposite juvenile leaves (series *Terminalipterae*). Tjuta belongs with about a dozen species in the *Isobilaterals*, in a further subdivision which is characterised by having non or scarcely peltate seedling and juvenile leaves, and relatively narrow adult leaves compared with a related group which includes *E. greeniana* and *E. latifolia*. Tjuta has been confused with long-fruited bloodwood (*E. polycarpa*) of tropical Australia, which differs by the discoloured adult leaves and pruinose buds. In desert regions tjuta can grow near sand dune bloodwood (*E. chippendalei*) which is confined to the dunes, and which differs by the non-scurfy buds and the fruits lacking a neck. Carr and Carr (1987) and Hill and Johnson (1995) segregated a number of species from tjuta from areas throughout its geographic range (e.g. *E. centralis*, *E. opaca*, *E. orientalis*, *Corymbia tumescens*). The recognition of these taxa is contentious among workers familiar with tjuta in the field. Further research is required to determine their status.

Publication: *Eucalyptus terminalis*: J. Proc. Linn. Soc., Bot. 3, 89(1859); *Corymbia terminalis*: *Telopea* 6, 323 (1995). Type: Arnhem Land, Northern Territory, Jul. 1856, F. von Mueller.



Names: Botanical—Latin *terminalis* (terminal), refers to the terminal inflorescence. Common—of Aboriginal origin.

Bark: Rough over whole trunk and branches or diminishing part way up the bole, tessellated, light brown over colourful orange or red; upper branches smooth.

Leaves: Seedling—opposite, petiolate, ovate, 2.5–6.3 × 1.3–2.5 cm, slightly discoloured. Juvenile—opposite, petiolate, lanceolate, 6–15 × 2.5–3.8 cm, light green, slightly discoloured. Intermediate—alternate, petiolate, broad-lanceolate, 10–15 × 3.8–5 cm, slightly discoloured. Adult—alternate, petiolate, lanceolate, 10–15 × 1.3–2.5 cm, dull or maturing glossy, light green to yellow-green, concolorous.

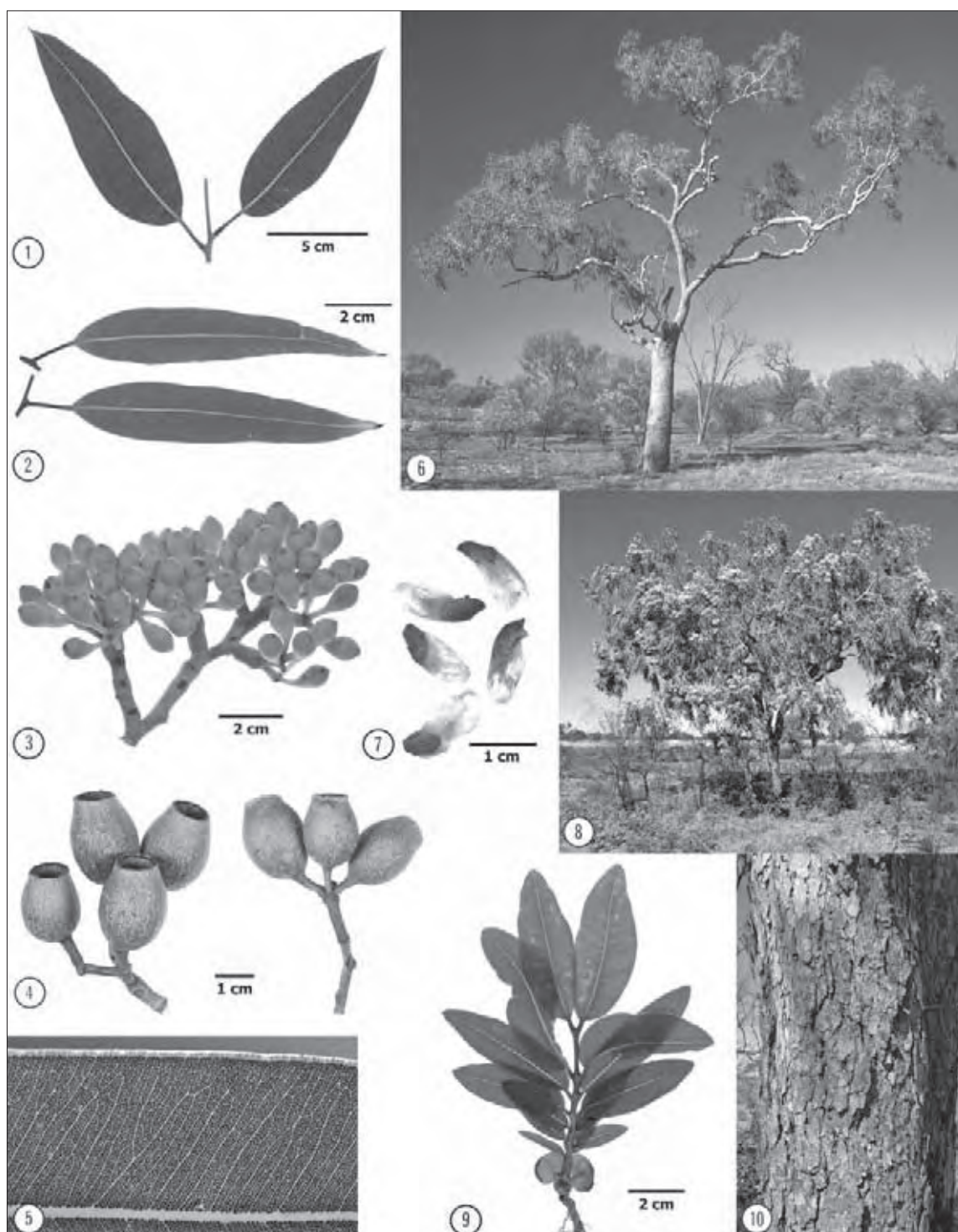
Inflorescences: Terminal panicles; unit inflorescences 7-flowered; peduncles terete, 0.5–1 cm long; buds pedicellate, pyriform to globular, 0.6–1 × 0.4–0.7 cm, cream, scurfy. Flowers Mar.–Aug.

Fruits: Pedicellate, urceolate, 1.5–2.4 × 1–2 cm; disc broad, descending; valves 4, deeply enclosed. Seeds elliptical, winged, red-brown, hilum subterminal, near to one edge.

Wood: Sapwood white, heartwood dark red, durable, density 980 kg m⁻³; used for fencing and firewood.

Climate: Altitudinal range: 10–750 m; Hottest/coldest months: 35–39°C/4–15°C; Frost incidence: low to moderate (in the south of its range); Rainfall: 300–1350 mm per year, summer max. to uniform.

Distinctive features: Small tree or rarely a mallee, with colourful, rough, tessellated, grey-brown outer bark over orange or red inner bark; concolorous adult leaves lacking an intramarginal vein; terminal panicles of 7-budded unit inflorescences; urceolate woody fruits; large woody galls present in crown. Tjuta is an important tree in Aboriginal mythology and has a range of traditional uses.



Eucalyptus terminalis 1. Intermediate leaves 2. Adult leaves 3. Buds 4. Fruits 5. Adult leaf venation 6. Tree, near Carnegie, W.A. 7. Seeds 8. Tree, near Winton, Qld 9. Seedling 10. Bark

Rough-leaved Bloodwood Desert Bloodwood

Eucalyptus setosa Schauer [*Corymbia setosa* (Schauer) K.D. Hill & L.A.S. Johnson]

Rough-leaved bloodwood is a small straggly tree, often in small pure stands, in clumps of several erect stems or trunks, or a medium-sized tree of good form. It may attain 20 m in height although usually it is a much smaller tree 8–10 m tall.

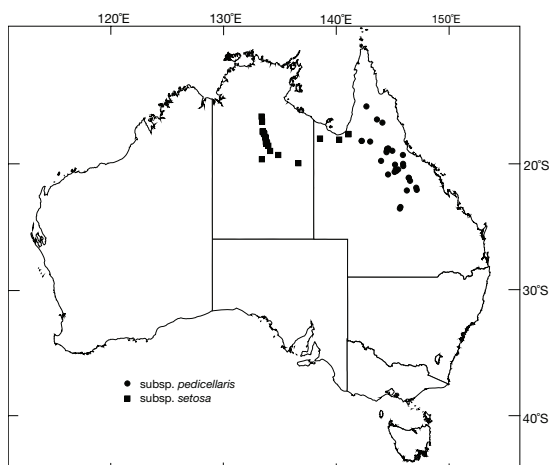
Rough-leaved bloodwood is widespread in northern Australia apart from Western Australia. Two forms are recognised, viz. subsp. *setosa*, which occurs in central eastern Northern Territory, from around Daly Waters to south of Tennant Creek, east to south of the Gulf of Carpentaria and islands nearby in Queensland, and subsp. *pedicellaris*, which occurs in eastern Queensland from Musgrave Station in south-eastern Cape York Peninsula southward to east of Barcaldine. The two subspecies intergrade in areas of contact.

This species commonly grows on low rocky hills where the soils are skeletal and sometimes lateritic, stony siliceous or lateritic rises, sand plains or sometimes sand dunes. It may extend to country of low relief where the soils vary from deep red sandy loams to well-drained sandy soils of moderate depth. Soils include residual sands and sandy red earths.

Rough-leaved bloodwood occurs in open woodlands and open forests. In the higher rainfall parts it may grow associated with Darwin woollybutt (*E. miniata*) and Darwin stringybark (*E. tetradonta*), but in the driest areas there may be only a sparse occurrence of arid zone wattles (*Acacia* spp.) and spinifex (*Triodia* spp.).

Related species: Brooker (2000) placed rough-leaved bloodwood in the predominantly northern section *Septentrionales*. The *Septentrionales* divide into two large subsections based on the presence (subsection *Alatae*) or absence (subsection *Apterae*) of wings to the seeds. The winged-seeded group divides into three taxonomic series diagnosed by the adult leaves being discolorous (*Dorsiventrals*), concolorous leaves (*Isobilaterals*), and those species characterised by the leaves of the adult plant being in opposite pairs (*Terminalipterae*). Rough-leaved bloodwood belongs with about a dozen species in the latter series and has close affinities to a number of species segregated by Hill and Johnson (1995). These include *E. dunlopiana*, which occurs in the Top End of the Northern Territory, and differs by the larger leaves, much longer bristles, pruinose branchlets, 3-flowered inflorescences, and pink flowers, *E. papillosa*, also of the Top End which has the smallest fruit of the group, and *E. chartacea* which is restricted to north-western Arnhem Land and adjacent country, and which differs by the pruinose branchlets and larger, non-setose leaves and larger fruits.

Publication: *Eucalyptus setosa*: Schauer in Walpers, *Rep. Bot. Syst.* 2: 926 (1843); *Corymbia setosa*: *Telopea* 6, 356 (1995). Type: Queensland: Allen Is. [Allen I], 20 Nov. 1802, R. Brown & Ferd. Bauer (Bennet 4782). Subsp. *pedicellaris* K.D. Hill & L.A.S. Johnson: *Telopea* 6, 358 (1995). Type: 38.0 km W of Charters Towers on highway, 28 Jul. 1990, K. Hill 3715 & L. Stanberg.



Names: Botanical—from the Latin, *setosus* (setose) referring to the scabrid leaf surface. Common—refers to the rough surface texture of the leaves and to the bloodwood group of eucalypts.

Bark: Rough to the small branches, thick, flaky, deeply tessellated and fissured, light grey-brown over red-brown.

Leaves: Throughout the life of the tree the leaves are opposite, usually decussate, and sessile or very shortly pedicellate. Seedling—ovate to ovate-lanceolate, 1.3–2.5 × 0.5–1.3 cm; scattered reddish hairs and numerous small glands on the edges, lateral veins few, at varying angles to the midrib but mainly around 45°. Juvenile—opposite, sessile, ovate, somewhat smaller than the adult, 3–10 × 2–4 cm, hairy, dull green, concolorous. Adult—these vary from almost smooth, lanceolate and about 10 × 2.5 cm, to broadly and often bluntly ovate, the latter nearly always with a cordate base, 2.5–7 × 1.5–4.5 cm. The broader leaves may be smooth but are often hairy. Branchlets are also usually hairy.

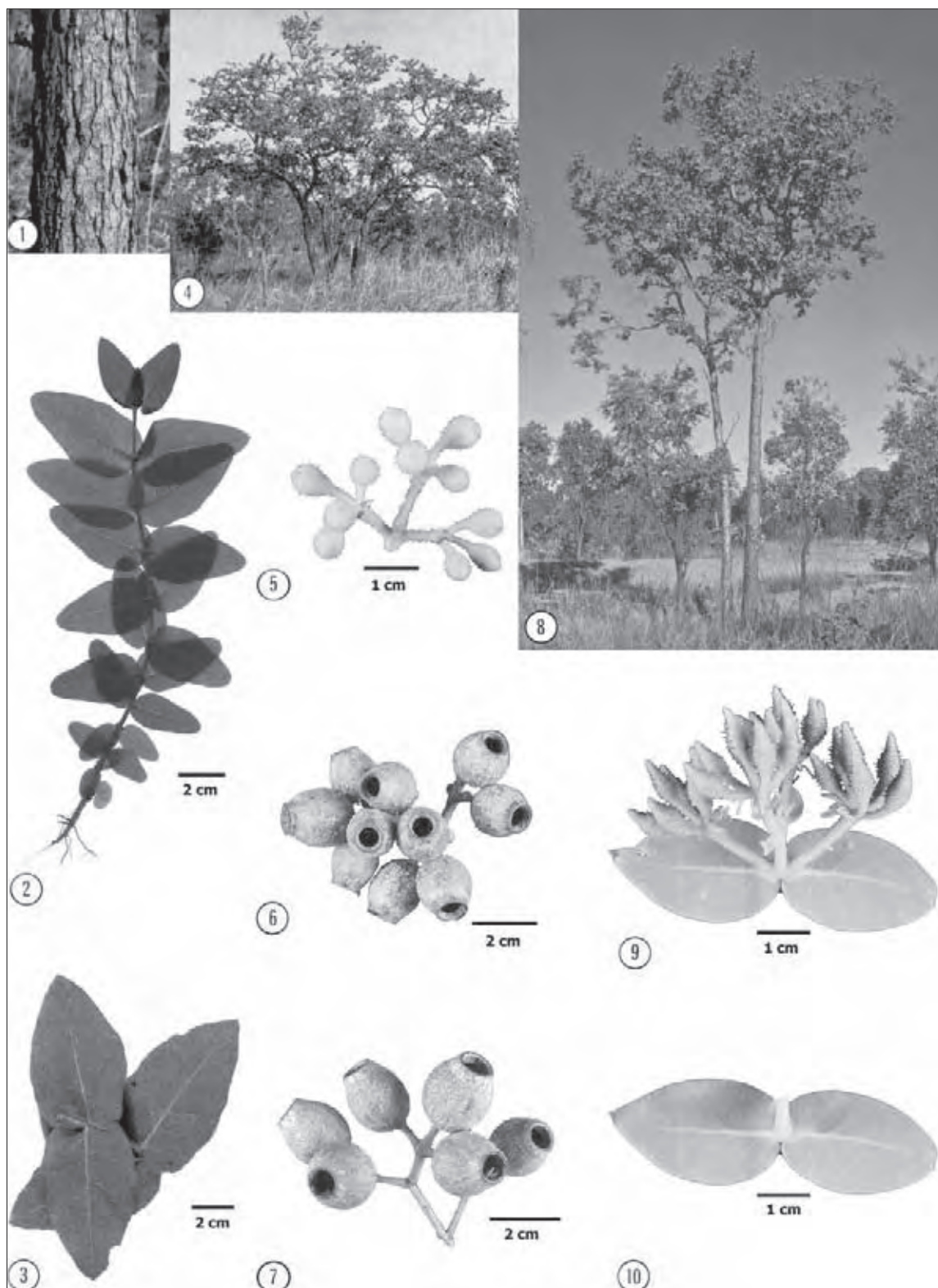
Inflorescences: Terminal, compound; unit inflorescences 7-flowered; peduncles terete, 0.5–1 cm long; buds pedicellate, pyriform, with long hairs, 0.6–0.8 × 0.5–0.7 cm, opercula conical or fusiform, flowers white. Flowers Nov.–Dec.

Fruits: Pedicellate, truncate-ovoid to slightly urceolate, hairy (scabrid), 1.5–2.3 × 1.5–2 cm; disc broad, descending; valves 3 or 4, deeply enclosed. Seeds elliptical, winged, red-brown, hilum subterminal, near to one edge.

Wood: Reddish, moderately hard and tough; trees are usually piped and the timber is of little value apart from firewood.

Climate: Altitudinal range: 100–700 m; Hottest/coldest months: 33–35°C/10–12°C; Frost incidence: low; Rainfall: 475–1025 mm per year, summer max.

Distinctive features: A readily identified straggly tree with rough, tessellated bark and opposite leaves at all stages; branchlets, younger leaves and all parts of the inflorescence are strongly hispid with reddish hairs up to 2.5 mm long; flowers occur in a terminal cluster comprising 7-budded units; fruits are globular, woody and moderately large.



Eucalyptus setosa 1. Bark 2. Seedling 3. Mature leaves 4. Tree, near Daly Waters, N.T. 5. Buds 6, 7. Fruits 8. Tree, Lynd Junction, Qld 9. Buds from near Tenant Creek, N.T. 10. Juvenile leaves

Brown Bloodwood

Eucalyptus trachyphloia F. Muell. [*Corymbia trachyphloia* (F. Muell.) K.D. Hill & L.A.S. Johnson]

Brown bloodwood is a small to medium-sized tree commonly to 20 m or occasionally 25 m tall with an erect bole, breaking at about half tree height. Rarely, it is reduced to a mallee form on harsh sites.

Brown bloodwood is widespread in eastern Australia extending from Mt Mulligan, north-west of Mareeba in Queensland, south to the Goulburn River valley in New South Wales. There are three forms which Hill and Johnson (1995) distinguished on differences in the occurrence of leaf stomata ($\times 100$ mag. required).

This species grows almost exclusively in shallow, siliceous soils on sandstone outcrops in open woodlands or open forests.

Brown bloodwood is not known to form pure stands although it is a common species on inland sites. Associated inland species include red ironbark (*E. sideroxylon*), narrow-leaved grey box (*E. pilligaensis*) and cypress pine (*Callitris glaucophylla*). On coastal sites it tends to occur as scattered trees associated with a wide range of other eucalypts, especially other bloodwoods.

Related species: Brooker (2000) placed brown bloodwood in the predominantly northern section *Septentrionales*. The *Septentrionales* divide into two large subsections based on the presence (subsection *Alatae*) or absence (subsection *Apterae*) of wings to the seeds. Brown bloodwood belongs to the smaller subsection *Apterae*, which is divided into five series. Of these, it most resembles the yellow bloodwoods (series *Naviculares*) from which it differs in the smaller, strongly discoloured leaves, more delicate buds and fruit, and the retention of the outer operculum of the buds to flowering.

Publication: *Eucalyptus trachyphloia*: J. Linn. Soc., Bot. 3, 90 (1859); *Corymbia trachyphloia*: *Telopea* 6, 227 (1995). Type: On hills near the Burnett River, Queensland, F. von Mueller.

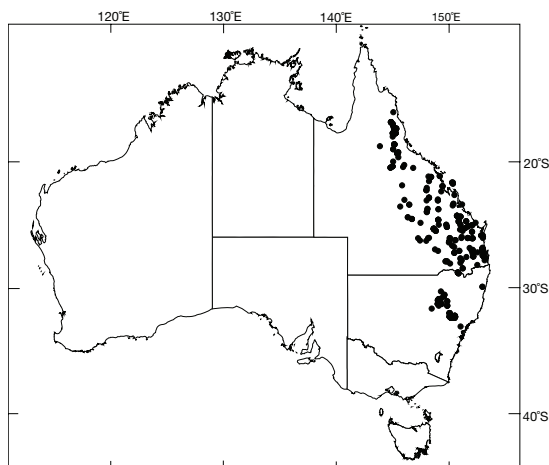
Names: Botanical—Greek *trachy* (rough, shaggy), *phloios* (bark). Common—refers to the colour of the bark and to the bloodwood group of eucalypts.

Bark: Rough to the smaller branches, flaky, irregularly tessellated, brown to yellow-brown.

Leaves: Seedling—opposite, sessile, peltate, broad-lanceolate, $2.5\text{--}3.8 \times 1\text{--}1.5$ cm, hairy. Juvenile—subopposite then alternate, shortly petiolate, peltate, elliptical to lanceolate, $5\text{--}12 \times 1\text{--}3.5$ cm, later leaves glossy green above, whitish green and hairy below. Intermediate—alternate, petiolate, ovate to oblong or broad-lanceolate, $7.5\text{--}14 \times 2.5\text{--}3.8$ cm, somewhat setose, slightly discoloured. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, $6.5\text{--}13 \times 1\text{--}2.6$ cm, dull, green to light green, discoloured.

Inflorescences: Terminal panicles, unit inflorescences 7-flowered; peduncles terete, $0.4\text{--}1.3$ cm long; buds pedicellate, pyriform, 0.5×0.3 cm, opercula rounded to slightly beaked. Flowers Jan.–Mar.

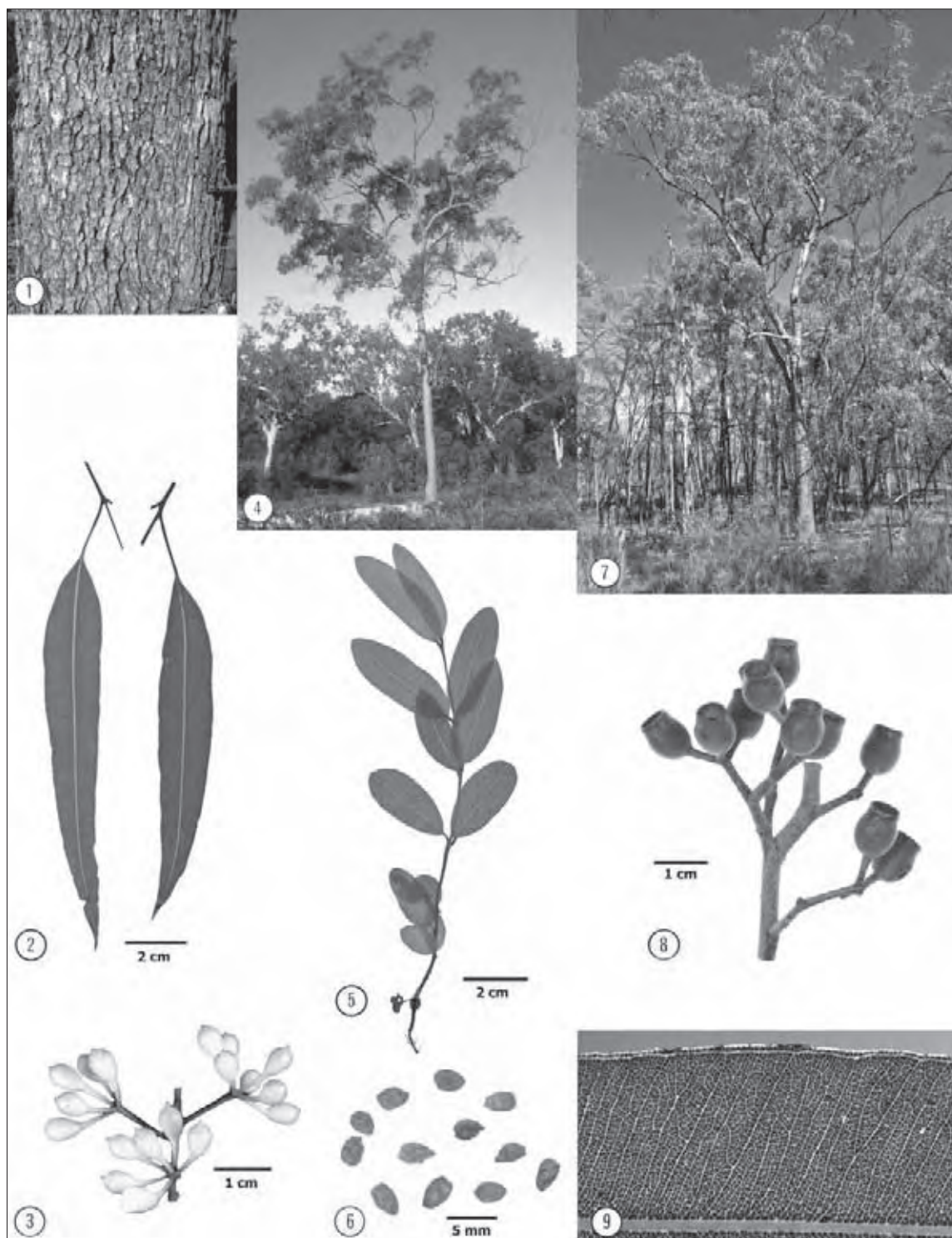
Fruits: Pedicellate, urceolate or barrel-shaped, $0.6\text{--}1 \times 0.5\text{--}0.8$ cm; disc broad, descending; valves 3 or 4, deeply enclosed. Seeds round to elliptical, non-winged, brown, hilum ventral.



Wood: The wood is susceptible to *Lyctus* borers and yellowish brown in colour with an open grain. It is of moderate strength and durability and density is 1020 kg m^{-3} . When available in sufficient quantity it has been sawn for constructional purposes and has also been used for mine props, fencing and fuel wood.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest months: $29\text{--}30^\circ\text{C}/6\text{--}8^\circ\text{C}$; Frost incidence: low; Rainfall: 730–1800 mm per year, summer max. but uniform in the south of its range.

Distinctive features: Small to medium-sized tree with rough, soft, flaky, irregularly tessellated, brown to yellow-brown bark; terminal panicles of 7-budded unit inflorescences; persistent outer operculum; small, urceolate to barrel-shaped fruits which are small compared to other bloodwoods.



Eucalyptus trachyphloia 1. Bark 2. Adult leaves 3. Buds 4. Tree, near Carmila, Qld 5. Seedling 6. Seeds 7. Tree, near Yetman, Qld 8. Fruits 9. Adult leaf venation

Rustyjacket and Leichhardt's Rustyjacket

Eucalyptus peltata Benth. [*Corymbia peltata* (Benth.) K.D. Hill & L.A.S. Johnson] and *Eucalyptus leichhardtii* Bailey [*Corymbia leichhardtii* (Bailey) K.D. Hill & L.A.S. Johnson]

Rustyjacket maintains a canopy in the juvenile leaf phase, while Leichhardt's rustyjacket develops typical adult leaves. These are medium-sized trees up to 18 m tall and around 0.4 m dbh. On poor sites, where they frequently grow, they are typically of poor form and only 6–10 m high. Sometimes the trunk is of good form for 3–4 m but usually it is crooked and divides into several large branches to form a rather open crown. *E. peltata* has two subspecies, the typical and subsp. *dimorpha*.

These taxa are endemic to Queensland. Subsp. *peltata* extends south-west of Charters Towers to east of Forsyth while subsp. *dimorpha* is restricted to the Harveys Range–Laroonia region west of Townsville. *E. leichhardtii* is distributed in scattered localities from west of Mareeba south to the Springsure and Robinson Gorge National Park.

These species grow on well-drained slopes where the soils are often skeletal and of low fertility. Parent rocks include granites, sandstone and, occasionally, porphyry and auriferous formations. They mainly grow in open eucalypt forests or woodlands mainly associated with ironbarks (e.g. *E. crebra*, *E. melanophloia*, *E. shirleyi*) or other bloodwoods (e.g. *E. dallachiana*).

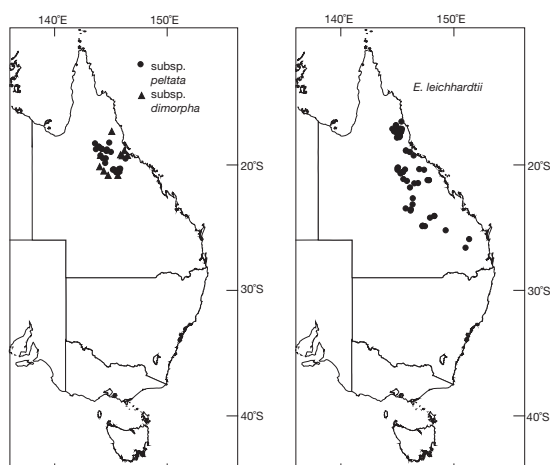
Related species: Brooker (2000) placed these two species among many species of the largely northern, eastern and central section *Septentrionales*. The rustyjacket group is distinguished from the other rough-barked bloodwoods by the flaky, soft, yellow to brown rough bark, and the early loss of the outer operculum. Rustyjacket is distinguished from yellowjacket (*E. bloxsoni*) by the larger buds, and opercula of nearly the same colour as the hypanthia. Large-fruited yellowjacket (*E. watsoniana*) has much larger fruits and a more southerly distribution, while yellow bloodwood (*E. eximia*), a New South Wales endemic, from south of Sydney to the Hunter Valley, has fruits of intermediate size and larger, curved leaves. Typical rustyjacket is easily recognised by the juvenile-leaved mature crown. Hill and Johnson (1995) treated subsp. *dimorpha* as a distinct hybridogenous species.

Publication: *Eucalyptus peltata*: Fl. Austral. 3, 254 (1867); *Corymbia peltata*: Telopea 6, 381 (1995). Type: Newcastle Range (SE of Georgetown), Queensland, 1856, F. von Mueller. *E. leichhardtii*: Qld Agric. J. 16, 493 (1906); and *C. leichhardtii*: Telopea 6, 370 (1995). Type: *E. leichhardtii*—near Alice, Central Railway (W. of Jericho), Queensland, W. Pagan.

Names: Botanical—*peltata*, Latin *peltatus* (peltate) referring to the leaves; *leichhardtii* honours the explorer F.W.L. Leichhardt (1812–1848). Common—alludes to the colour of the bark and to the explorer.

Bark: Rough and persistent on the trunk and larger branches, short-fibred, irregularly tessellated and flakier than most bloodwoods, moderately soft. The outer layers are brown to yellowish brown but the more recently formed bark is distinctly yellow. This bark is typical of the yellow bloodwood group.

Leaves: Seedling—a few pairs opposite then alternate, petiolate, peltate, ovate, 4–13 × 2.5–5.5 cm (*peltata*) or very variable in shape, ovate to broad-lanceolate, 6–14 × 2–5 cm



(*leichhardtii*), pale green, slightly discolorous, setose. Juvenile—alternate, petiolate, peltate, ovate, 12–18 × 5.5–7 cm, pale green, slightly discolorous, setose (*peltata*) or ovate to broad-lanceolate, 10–20 × 3–7 cm; some specimens become glabrous and glossy green early, others remain setose and pale green for many pairs (*leichhardtii*). Intermediate—alternate, petiolate, broad-lanceolate, 14–23 × 4–5 cm, glossy green, almost concolorous (*leichhardtii*). Adult phase—alternate, petiolate, nearly always peltate, almost orbicular to ovate, 4.5–13 × 3.5–10 cm, pale green and yellow-green, almost concolorous (*peltata*) or lanceolate, 11–16 × 1.7–2.5 cm, glossy green, concolorous (*leichhardtii*). Subsp. *dimorpha* has a mature crown of large scabrid juvenile leaves mixed with glabrous, elliptical, non-peltate leaves, to 17 × 6 cm, that are dull, bluish green.

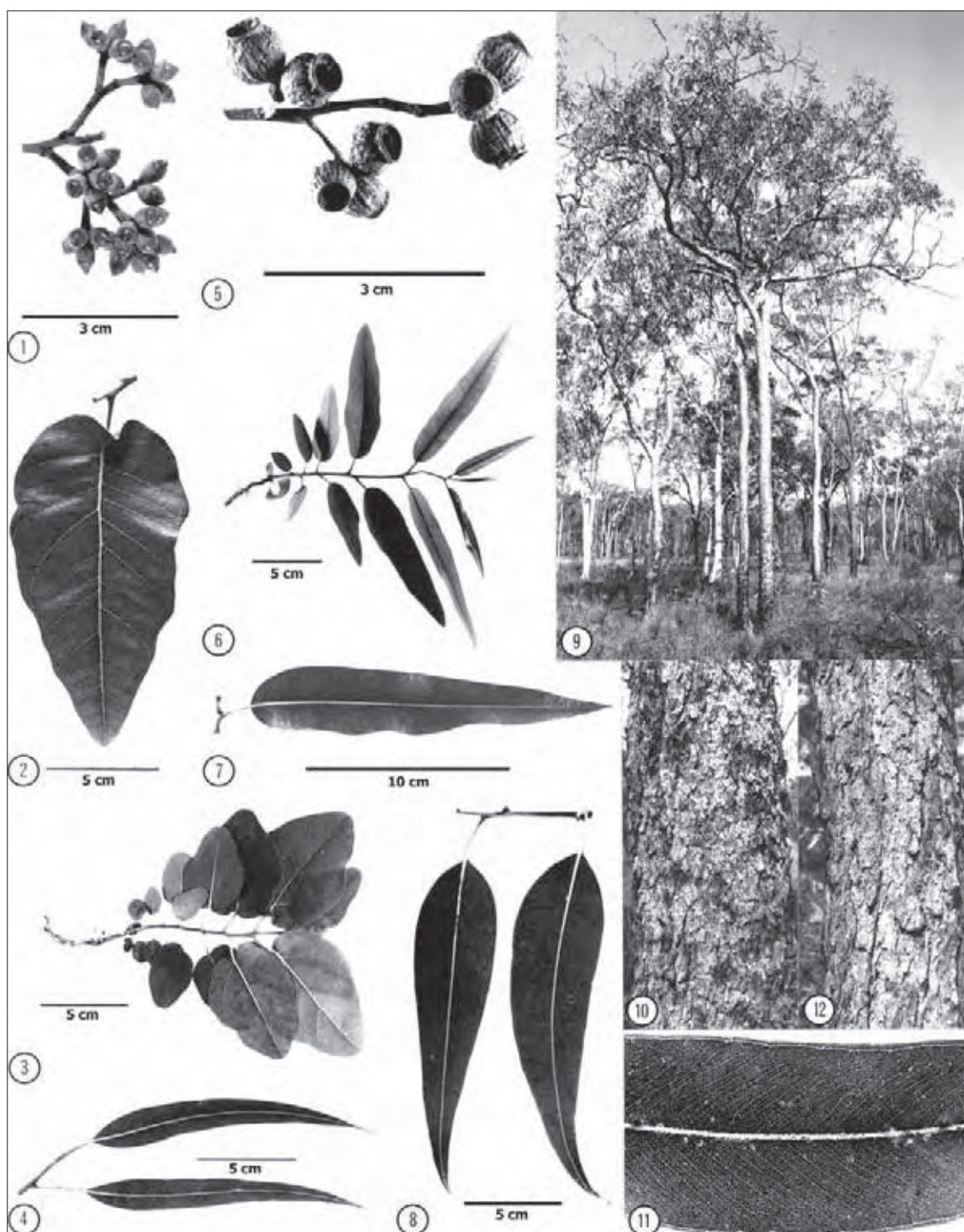
Inflorescences: Moderately large, terminal panicles, unit inflorescences 7-flowered; peduncles terete or slightly angular, 0.5–2.3 cm long; pedicels absent or up to 0.3 cm long; buds ovoid, 0.6–1 × 0.4–0.6 cm; hypanthia striated (often pruinose for subsp. *peltata*); opercula hemispherical to shortly conical, smooth, shiny, brown in colour (inner opercula), contrasting vividly with the greenish hypanthia. Flowers Jan.–Mar.

Fruits: Sessile or shortly pedicellate, ovoid or slightly to distinctly urceolate, 0.7–1.5 × 0.7–1.2 cm, often with numerous faint striations and sometimes warty; disc broad, descending; valves 3 or 4, deeply enclosed. Seeds elliptical, non-winged, red-brown, shiny, hilum ventral.

Wood: Heartwood brown to reddish brown, heavy, strong and durable, kino (gum) veins common; grain fine, wavy, with intermediate texture, density about 800–970 kg m⁻³; probably rarely utilised.

Climate: Altitudinal range: 50–900 m; Hottest/coldest months: 34–37°C/6–12°C; Frost incidence: low; Rainfall: 500–900 mm per year, summer max.

Distinctive features: Yellowish bloodwood bark; moderately large, terminal panicles and small, two-coloured, sessile or very shortly pedicellate buds; fruits ovoid or urceolate; juvenile leaves setose, scabrous and peltate.



Eucalyptus peltata: (p), *Eucalyptus leichhardtii* (l) 1. Buds (l) 2. Juvenile leaf (p) 3. Seedling (p) 4. Adult leaves (l) 5. Fruits (l) 6. Seedling (l) 7. Juvenile leaf (l) 8. Intermediate leaves (l) 9. Trees (l), west of Herberton, Qld 10, 12. Bark (l) 11. Adult leaf venation (l).

Yellow Bloodwood

Eucalyptus eximia Schauer [*Corymbia eximia* (Schauer) K.D. Hill & L.A.S. Johnson]

Yellow bloodwood is a small to medium-sized woodland tree, to 15 m in height and 0.7 m dbh, rarely taller. The bole is usually straight, branching at half tree height to produce a dense crown and is one of the more attractive species of its area. It may be reduced in stature and be several-stemmed on harsh sites. Between brownish scales of the tessellated older bark can be readily seen the yellowish, inner bark, from which it gets its common name.

This species is endemic to New South Wales, occurring from Pokolbin in the north, southwards to west of Nowra and the Shoalhaven River. These places are within about 160 km of Sydney and it extends no further than 80 km inland from the coast. It is not a common species over large areas but is most common in the Galston Gorge on Berowra Creek, Mount Colah and Bobbin Head regions north of Sydney. It is moderately common between Glenbrook and Blaxland in the foothills of the Blue Mountains.

Yellow bloodwood grows on broad flat-topped ridges and steep, rugged upper slopes of valleys. It is found on sandy, often shallow soils derived from sandstone.

Yellow bloodwood occurs in open or low open woodlands. Associated species include scribbly gums (*E. racemosa*, *E. haemastoma*), red bloodwood (*E. gummifera*), Sydney peppermint (*E. piperita*), white stringybark (*E. globoidea*), grey gum (*E. punctata*) and smooth-barked apple (*Angophora costata*).

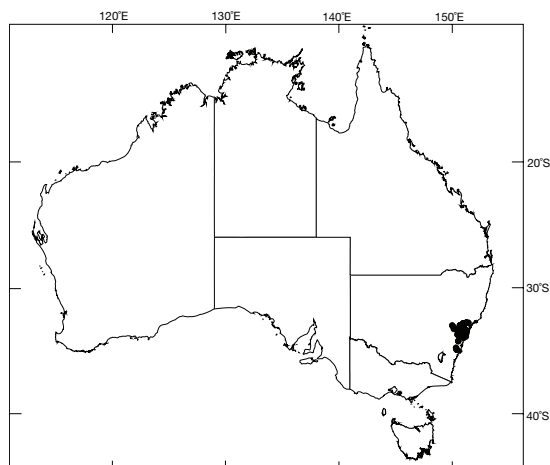
Related species: Brooker (2000) placed yellow bloodwood in the predominantly northern section *Septentrionales*. This species of yellow bloodwood is an exception, however, as it is found only in New South Wales. The *Septentrionales* divide into two large subsections based on the presence (subsection *Alatae*) or absence (subsection *Apterae*) of wings to the seeds. Yellow bloodwood belongs to the smaller subsection *Apterae*, which is divided into five series and belongs to the largest of these—*Naviculares*. Its bark character is similar to that of brown bloodwood (*E. trachyphloia*), which differs in the smaller discoloured leaves, more delicate buds and fruit, and the retention of the outer operculum of the buds to flowering.

Publication: *Eucalyptus eximia*: Walpers, *Rep. Bot. Syst.* 2, 925 (1843); *Corymbia eximia*: *Telopea* 6, 383 (1995). Type: banks of the Grose River, Sept.–Oct. 1803, R. Brown & F. Bauer (Bennet 4776).

Names: Botanical—Latin *eximia* (exceptional, uncommon, extraordinary), allusion obscure, but it may reflect the observation of the discoverer, as it is likely to have been the first yellow bloodwood, with its striking terminal inflorescences of cream or yellow flowers and yellowish new bark, to be encountered by him.

Bark: Rough to the smaller branches, flaky, irregularly tessellated, more flaky than most bloodwoods, the outer layers of the flakes are brownish but the more recently formed bark is a distinct yellow.

Leaves: Seedling—opposite for 3–6 pairs, shortly pedicellate, peltate, elliptical to lanceolate, 2.5–5 × 0.7–1.5 cm; minutely



hairy, slightly discoloured. Juvenile—subopposite to alternate, petiolate, oblong-lanceolate, 7.5–12.5 × 2.5–3.2 cm, light green to bluish green. Intermediate—alternate, petiolate, broadly lanceolate or falcate, 15.2–20 × 3.8–4.5 cm, sometimes larger, non-peltate, concolorous, firm texture. Adult—alternate, petiolate, usually falcate and often with a finely tapered point, 12.5–20 × 1.2–3 cm, dull, light green to bluish green, concolorous, very firm texture.

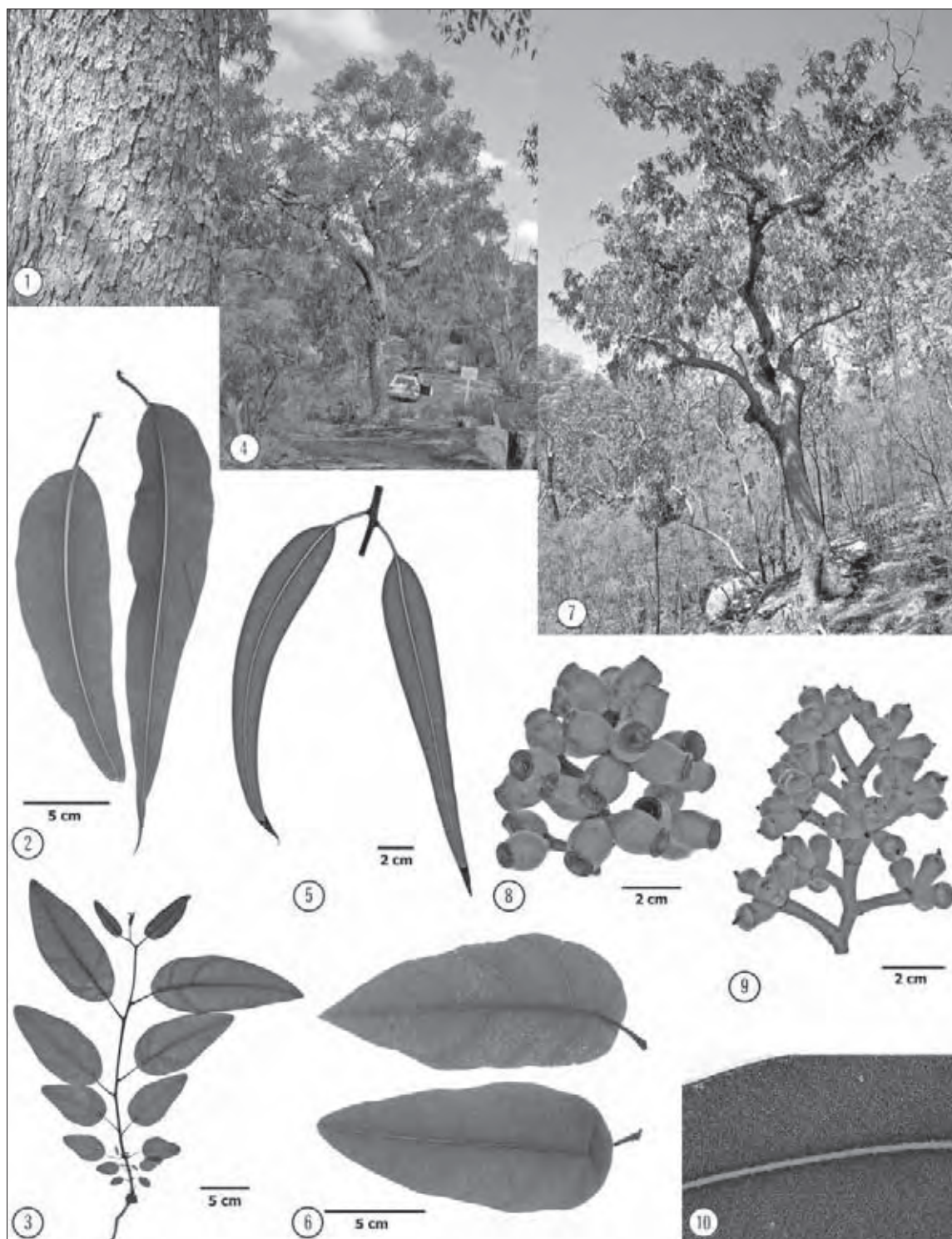
Inflorescences: Terminal panicles, unit inflorescences 7-flowered, peduncles stout to 4 cm long; buds sessile to shortly pedicellate, pyriform to clavate, 1.3–1.5 × 0.6 cm, opercula conical or slightly beaked, filaments cream or sometimes yellow. Flowers Aug.–Nov.

Fruits: Sessile to very shortly pedicellate, barrel-shaped to slightly urceolate, 1.5–2 × 1–1.6 cm; disc broad, descending; valves 3 or 4, deeply enclosed. Seeds flattened-ovoid to cymbiform, non-winged, red-brown, hilum ventral. Mature Mar.–Jul.

Wood: Hard, heavy, sapwood pale grey, highly susceptible to *Lyctus*, heartwood durable; pinkish to pale yellow-brown, density around 750–990 kg m⁻³; kino (gum) veins are not as common in this species as in most other bloodwoods. Because of small log size and limited availability, the timber was only used to a very small extent.

Climate: Altitudinal range: 90–500 m; Hottest/coldest months: 26–27°C/4–5°C; Frost incidence: low to moderate; Rainfall: 800–1200 mm per year, uniform.

Distinctive features: Small tree with rough, flaky, yellow new bark ageing yellow-brown; concolorous, usually falcate leaves; large, terminal panicles of 7-budded unit inflorescences; outer operculum shed early; robust, to barrel-shaped to slightly urceolate fruits.



Eucalyptus eximia 1. Bark 2. Intermediate leaves 3. Seedling 4. Tree, Galston Gorge, N.S.W. 5. Adult leaves 6. Juvenile leaves 7. Tree, St Albens-Buckety, N.S.W. 8. Fruits 9. Buds 10. Adult leaf venation

Cadaga Cadaghi

Eucalyptus torelliana F. Muell. [*Corymbia torelliana* (F. Muell.) K.D. Hill & L.A.S. Johnson]

Cadaga is a medium-sized to tall tree usually reaching 20–30 m in height and about 1 m dbh, generally of good form with a straight bole to two-thirds of total height. Tallest trees may be up to 40 m tall. It is one of a small number of eucalypt species associated with tropical rainforests, believed to be due to invasion of eucalypt-dominated wet sclerophyll forests by rainforest species in recent decades.

This species occurs in a narrow belt some 50–80 km wide between coastal plains and the top of the adjacent ranges in northern Queensland. The distribution extends about 150 km north and 200 km south of Cairns, from Cedar Bay National Park and Helenvale, near Cooktown in the north, to west of Ingham in the south.

Cadaga grows on the slopes of the coastal range on sandy loams derived from granites and metamorphic rocks, where drainage is good, yet soil moisture retention is high.

The species is generally found in tall open forest on the margins of closed tropical rainforest or occasionally in the rainforest assemblage. Associated eucalypt species include large-fruited red mahogany (*E. pellita*), pink bloodwood (*E. intermedia*) and forest red gum (*E. tereticornis*) as well as numerous rainforest species.

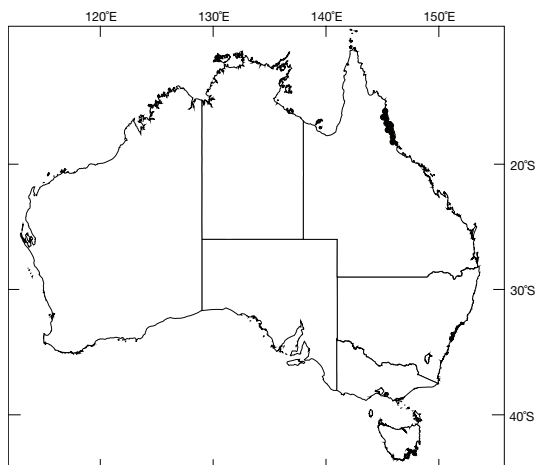
Related species: Brooker (2000) placed cadaga in the largely northern, eastern and central section *Septentrionales* and in the non winged-seeded subsection *Apterae*. Cadaga may be considered to be a species with links to both the yellow bloodwood group (rusty-jackets) and to the smooth-barked bloodwoods (spotted gums). Cadaga lacks both the rough flaky bark of yellow bloodwoods and the completely smooth bark of the spotted gums. Readily identified by its rainforest or near rainforest habitat, the scabrous juvenile and intermediate leaves of the mature canopy and the green upper bark.

Publication: *Eucalyptus torelliana*: *Fragm.* 10, 106 (1877); *Corymbia torelliana*: *Telopea* 6, 385 (1995). Type: Near Trinity Bay, Queensland, E. Fitzalan.

Names: Botanical—honours Count L. de Torelli (1810–1887), a member of the Italian Senate who promoted the use of eucalypts to dry up the malarial Pontine Marshes near Rome. Common—of Aboriginal origin.

Bark: Grey to black, subfibrous, scaly and subtessellated on the lower part of the trunk, smooth, green and slightly shiny above.

Leaves: Seedling—opposite for 1 or 2 pairs, then alternate, petiolate, peltate, broadly ovate, 5–12 × 3–8 cm, pale green, discolorous. Juvenile—alternate, petiolate, peltate, broadly ovate, 12–22 × 8–14 cm, green, discolorous. Stems, petioles and leaf veins in the seedling and juvenile stages have many simple hairs to 0.5 cm long. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 9–16 × 3.5–6.5 cm, only slightly hairy, becoming glabrous, green, slightly discolorous. Adult—alternate, petiolate, broad-lanceolate to lanceolate, 10–14 × 1.7–3.5 cm, glabrous, green, slightly discolorous. The adult leaf stage is comparatively rare, many trees having only juvenile and intermediate leaves, resulting in a very broad-leaved canopy.



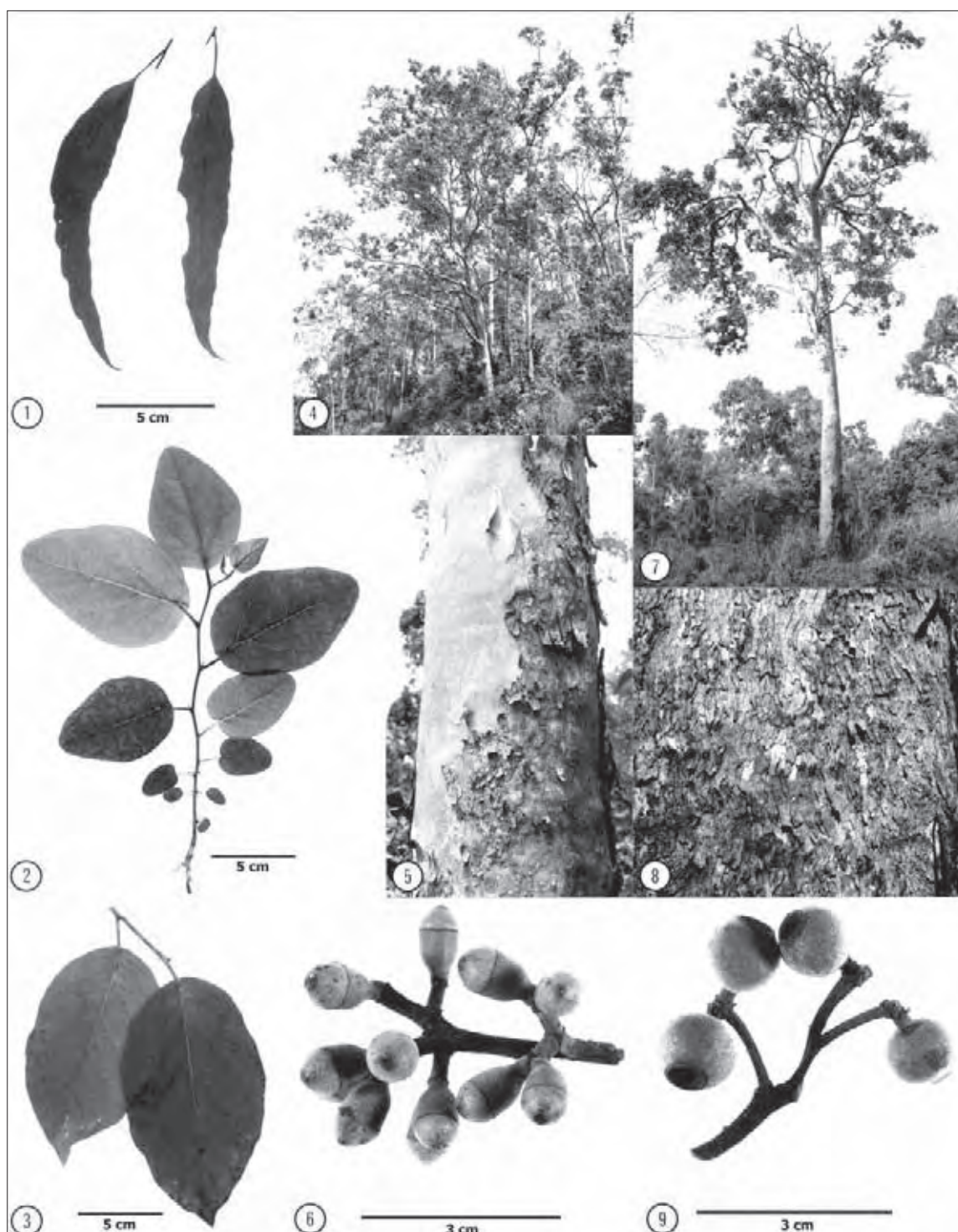
Inflorescences: Large, terminal panicles, unit inflorescences 7-flowered, peduncles terete, 0.5–2 cm long, pedicels absent or to 0.3 cm long; buds ovoid, 0.8–0.9 × 0.5–0.6 cm; opercula hemispherical-apiculate. Flowers Sept.–Oct.

Fruits: Sessile, ovoid to globular or globular-urceolate, 0.9–1.4 × 0.9–1.4 cm; disc broad, descending; valves 3, obscure, deeply enclosed. Seeds elliptical, non-winged, red-brown, hilum ventral. Mature Dec.–Mar.

Wood: Heartwood pale brown to brown, hard, strong, not very durable in the ground, fissile, subject to kino (gum) veins; density about 905–1010 kg m⁻³; due to its relative rarity the timber is not used to any extent now; formerly it was used for general construction, wagon building, scantlings and bridge decking.

Climate: Altitudinal range: 30–750 m; Hottest/coldest months: 29–31°C/12–15°C; Frost incidence: low; Rainfall: around 2000 mm per year, summer max.

Distinctive features: A non-lignotuberos eucalypt found only on the margins of and within rainforest; very distinctive green upper bark; juvenile leaves large, peltate and hairy; canopy usually comprising very broad leaves due to absence of adult leaf stage; flowers in large, terminal panicles; ovoid to globular-urceolate fruits which lack a central column after dehiscence. This is a widely cultivated species for amenity purposes throughout the summer rainfall zone of eastern Australia.



Eucalyptus torelliana 1. Adult leaves 2. Seedling 3. Juvenile leaves 4, 7. Trees, Kuranda district, Qld 5, 8. Bark 6. Buds 9. Fruits

Lemon-scented Gum *Variegata*, Lemon-scented Iron Gum, Spotted Iron Gum

Eucalyptus citriodora Hook. [*Corymbia citriodora* (Hook.) K.D. Hill & L.A.S. Johnson]

This species is a usually medium-sized to tall tree 25–35 m tall but sometimes reaches 60 m in height and 1.2 m dbh. It is of handsome appearance and usually of excellent form. Trees from northernmost stands are more graceful and have narrower, pendulous leaves and non-mottled bark. There are two subspecies.

Subsp. *citriodora* occurs at Mt Janet near Lakeland Downs and near Helenvale in the north, south along the Herberton Range to Mt Molloy, Hann Tableland, Atherton, Kuranda, with extensive stands in the Paluma to Ravenshoe region, south-west to the White Mountains–Mt Sturgeon region north east of Hughenden and south to the Eungella Range west of Mackay. More continuous stands occur from near the coast at Rockhampton and Bundaberg extending inland to west of Springsure. Subsp. *variegata* occurs over a large area from west of Maryborough inland to the Carnarvon Range and south to Coffs Harbour in New South Wales. Mixed stands of the two occur where their distributions overlap.

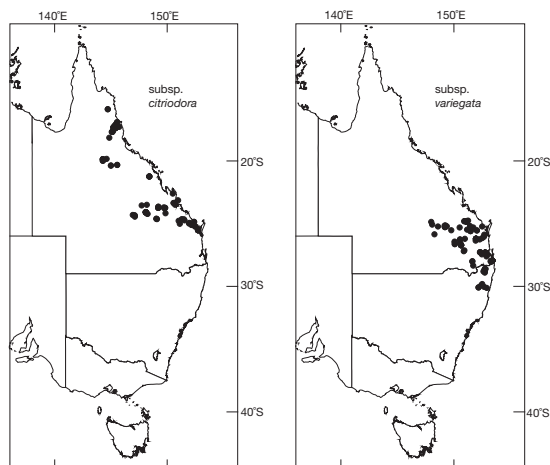
This species tends to occur on ridges and steep hills on well-drained, gravelly sands to sandy clay loams derived from granite, shale or sandstone. Subsp. *variegata* tends to favour clay loams and also has occurrences on basaltic or metasedimentary ranges.

Both subspecies occur mainly in open forests or woodlands, associated with a wide range of eucalypts, which include white mahogany (*E. acmenoides*), Gympie messmate (*E. cloeziana*), bloodwoods (*E. intermedia*, *E. clarksoniana*), ironbarks (*E. crebra*, *E. fibrosa*, *E. melanophloia*), grey gums (e.g. *E. longirostrata*) and smooth-barked apple (*Angophora costata* subsp. *leiocarpa*).

Related species: This species is closely related to the spotted gums (*E. maculata* and *E. henryi*) and placed in section *Septentrionales*, subsection *Apterae*, series *Maculatae* by Brooker (2000). This series is unique in the bloodwoods in that the inflorescences are compound in the upper axils of the current leafy shoots, not in leafless terminal panicles. *E. maculata* mainly differs by its strongly mottled bark and its thicker, wider leaves which have sparser reticulation and far fewer oil glands. *E. henryi* further differs by its larger leaves, buds and fruits.

Publication: *E. citriodora*: in Mitchell J. *Exped. Trop. Australia*, 235 (1848). Type: Balmy Creek (near Fairview Station, west of Springsure), Queensland, T. L. Mitchell. *E. variegata*: F. Muell., *J. Linn. Soc., Bot.* 3, 88 (1859). *C. variegata* (F. Muell.) K.D. Hill & L.A.S. Johnson: *Telopea* 6, 389 (1995). *C. citriodora* subsp. *variegata* A.R. Bean & M.W. McDonald: *Austrobaileya* 5, 735 (2000). Type: Burnett River, Queensland, 1856, F. von Mueller.

Names: Botanical—Latin *citron* (lemon), *odorus* (having a smell); Latin *variegatus* (variegated), for the spotted appearance of the bark. Common—from the strong lemon scent of the crushed leaves (*citriodora*).



Bark: Smooth to ground level, cream, pink or coppery depending on stage of weathering; mottled (spotted) in the south of its range grading to non-mottled in the north.

Leaves: Seedling—opposite for 3–5 pairs then alternate, petiolate, peltate, ovate, 6.5–17 × 2.3–7.5 cm, pale green, slightly discolorous, setose. Juvenile—alternate, petiolate, ovate to broad-lanceolate, 14–21 × 4.5–8 cm, some setose, pale green and peltate for many pairs, others soon becoming glabrous and glossy green. Stems, petioles and leaves (particularly veins) are covered with simple hairs to 0.5 cm long, in both the seedling and juvenile leaf stages. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 13–30 × 2–5 cm, green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 8–16 × 0.5–1.8 cm green, concolorous. At all stages the crushed leaves of subsp. *citriodora* smell of citronellal (lemon).

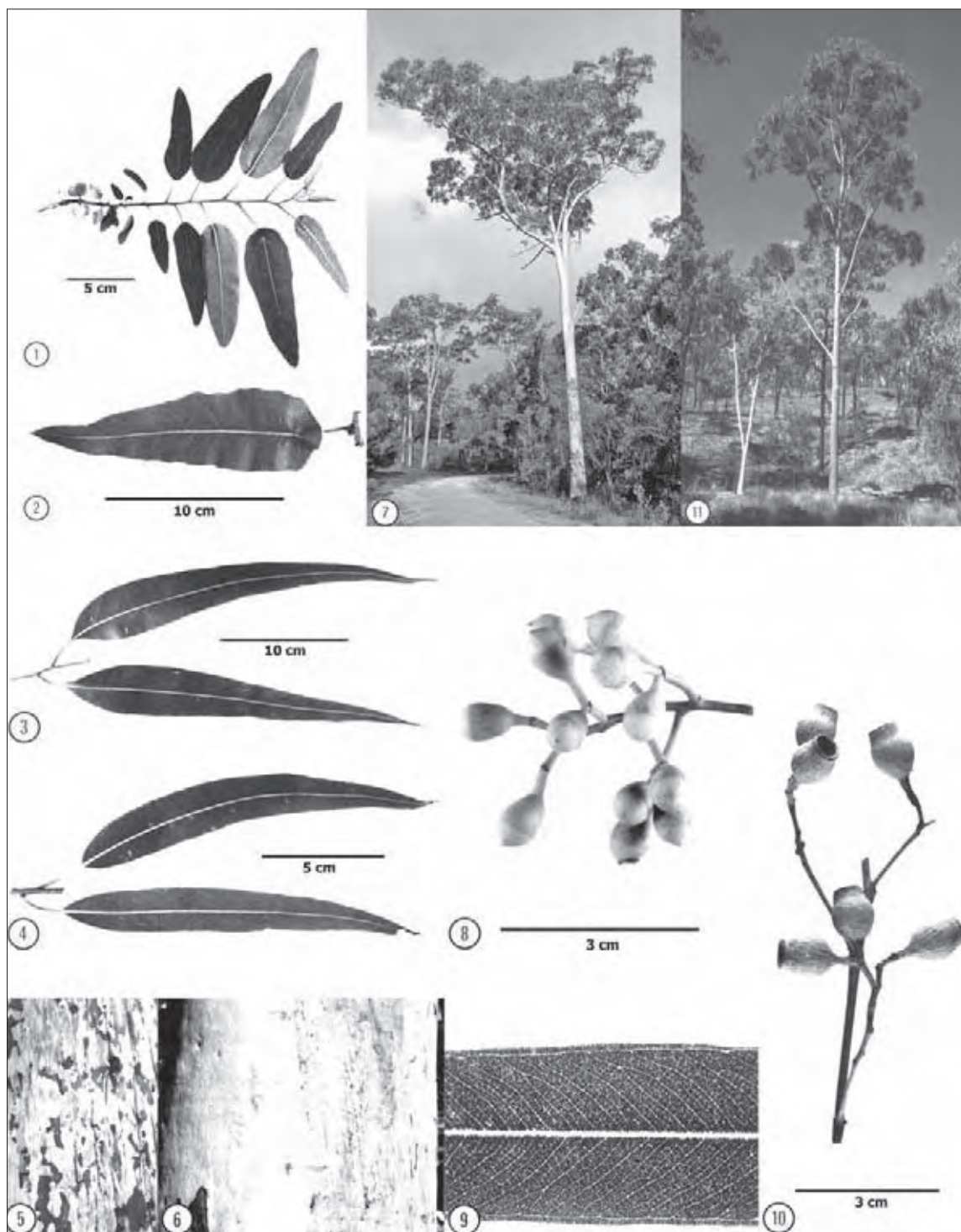
Inflorescences: Axillary, compound in the axils of the upper leaves, unit inflorescences 3-flowered; peduncles terete, 0.3–0.7 cm long; pedicels 0.1–0.6 cm long; buds clavate, 0.7–1 × 0.4–0.6 cm; opercula hemispherical-apiculate. Flowers Jun.–Nov.

Fruits: Pedicellate, ovoid or urceolate, often warty, 0.7–1.5 × 0.7–1.1 cm; disc broad, descending; valves 3 or 4, deeply enclosed. Seeds cymbiform (boat-shaped), non-winged, reddish black, hilum ventral.

Wood: Sapwood white, wide (up to 6 cm), and very susceptible to *Lyctus* borer attack; heartwood dark brown, grain straight or interlocked and occasionally wavy, texture open and coarse, hard, strong, tough, works fairly easily; often with a greasy feel; density about 950–1010 kg m⁻³; used for bridge construction, tool handles, framing, flooring and case manufacture. Wood similar to spotted gum (*E. maculata*).

Climate: Altitudinal range: 30–1100 m; Hottest/coldest months: 29–30°C/8–9°C (*citriodora*), 26–29°C/0–6°C (*variegata*); Frost incidence: low (*citriodora*), moderate to high (*variegata*); Rainfall: 600–2000 mm per year, summer max.

Distinctive features: Trees with smooth, cream, greyish pink, coppery or mottled bark; leaves lemon-scented (northern stands); inflorescences compound; fruits woody.



Eucalyptus citriodora: subsp. *citriodora* (c), subsp. *variegata* (v) 1. Seedling 2. Juvenile leaf 3. Intermediate leaves 4. Adult leaves 5. Bark (v) 6. Bark (c) 7. Tree, Durakai State Forest, Qld (v) 8. Buds 9. Adult leaf venation 10. Fruits 11. Tree, near Herberton, Qld (c)

Spotted Gum and Broad-leaved Spotted Gum

Eucalyptus maculata Hook. [*Corymbia maculata* (Hook.) K.D. Hill & L.A.S. Johnson] and *Eucalyptus henryi* Blake [*Corymbia henryi* (Blake) K.D. Hill & L.A.S. Johnson]

Spotted gums are tall trees on favourable sites, usually attaining 35–45 m in height and 1–1.3 m dbh. Exceptional specimens reach 70 m and exceed 3 m dbh. On drier and poorer sites they may be 20–35 m in height and 0.7–1.2 m in diameter or much smaller on exposed coastal headlands.

Spotted gum is widely distributed in the coastal areas of New South Wales from Manning River valley south to Bega. An isolated stand occurs in the Mottle Range, near Orbost in eastern Victoria. *E. henryi* occurs from near Grafton in subcoastal northern New South Wales, north to the Brisbane region and west to Toowoomba in south-eastern Queensland.

Spotted gum grows on a wide range of soils with best development on those that are well drained and of moderately heavy texture derived from shales. It also occurs very commonly on sandstone sites. It grows mainly on valley slopes and ridges. *E. henryi* occurs mainly on subcoastal plains and the foothills of adjacent ranges on sandy loams to clays derived from granite or shale.

Both species typically occur in open to tall open forests, sometimes in fairly pure stands but may also have a range of associated species including ironbarks (*E. paniculata*, *E. siderophloia*, *E. fibrosa*), blackbutt (*E. pilularis*), tallowwood (*E. microcorys*), grey gums (*E. propinqua*, *E. punctata*), Sydney blue gum (*E. saligna*), grey box (*E. moluccana*), white mahogany (*E. acmenoides*), brush box (*Lophostemon confertus*) and pink bloodwood (*E. intermedia*).

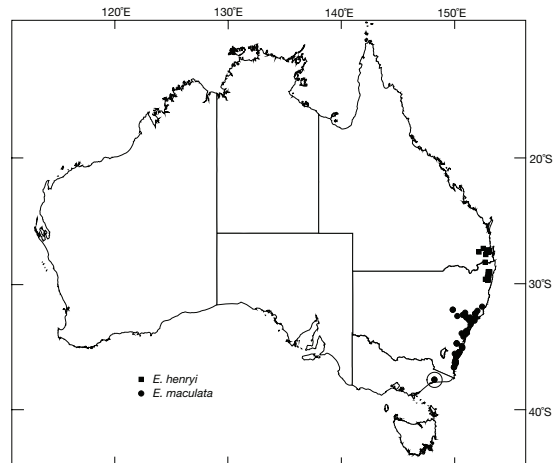
Related species: Brooker (2000) placed these two species in section *Septentrionales*, subsection *Aptrae*. They are closely related to lemon-scented gum (*E. citriodora*)—see this species for discussion.

Publication: *E. maculata*: *Icon. Pl.* 7, 619 (1844); *C. maculata*: *Telopea* 6, 393 (1995). Type: Maitland, New South Wales, c. 1837, J. Backhouse 37. *E. henryi*: *Austrobaileya* 1, 4 (1977); *C. henryi*: *Telopea* 6, 396 (1995). Type: Stafford, near Brisbane, Qld, 8 Jan. 1956, S.T. Blake 19889.

Names: Refer to the appearance of the bark; Latin *maculatus* (spotted, blotched); large-leaved spotted gum honours Neil Henry (b.1927–) a forester who first recognised the species.

Bark: Smooth to ground level, greenish cream (when fresh), yellowish, coppery brown or numerous shades of grey depending on stage of weathering. Bark is shed in patches which results in the characteristic spotted appearance.

Leaves: Seedling—opposite for 1–3 pairs then alternate, petiolate, ovate, 5–14 × 3.5–8 cm (*maculata*), ovate to broadly ovate, 12–20 × 5.5–8 cm (*henryi*), green, discolorous, up to 10 pairs peltate; stems, petioles and veins covered with small simple hairs or bristles (*maculata*) or sparsely setose and becoming glabrous (*henryi*). Juvenile—alternate, petiolate, ovate, 14–23 × 6.5–10.5 cm (*maculata*), broadly ovate to broadly elliptical and acuminate, 17–30 × 7–11 cm (*henryi*), green, slightly discolorous, a few pairs peltate, becoming glabrous and glossy. Intermediate—alternate, petiolate, broad-



lanceolate to lanceolate, 18–24 × 3–6 cm, green, (*maculata*), broad-lanceolate, 15–28 × 5–7 cm, glossy green (*henryi*), concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 12–21 × 1.2–3 cm, green (*maculata*), lanceolate, acuminate, 11–28 × 2.2–4.5 cm, glossy green (*henryi*), concolorous.

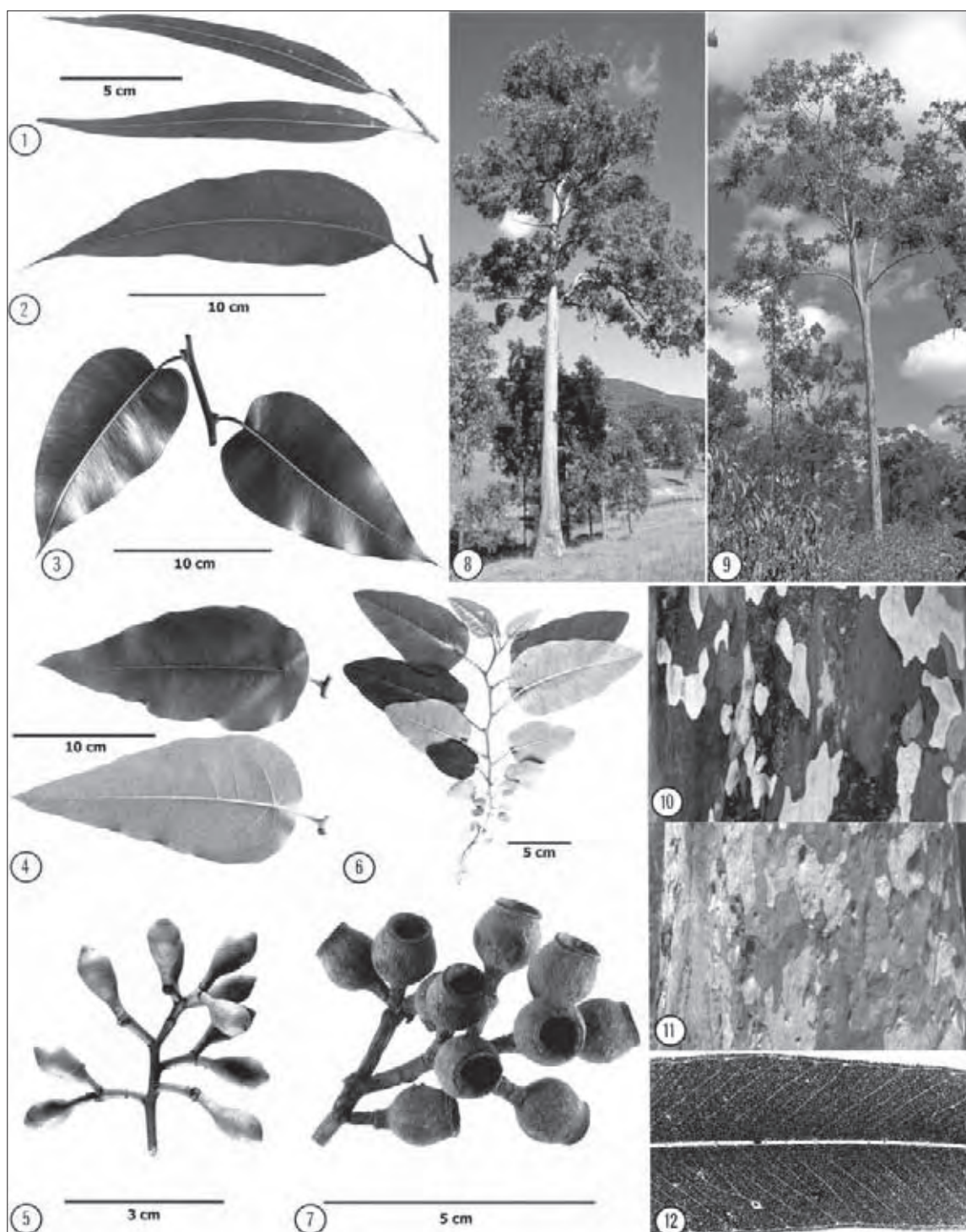
Inflorescences: Axillary, compound in the axils of the upper leaves, unit inflorescences 3-flowered (very rarely 7); peduncles more or less terete, 0.3–0.8 cm long; pedicels usually angular, 0.3–0.7 cm long; buds more or less ovoid, 0.6–1 × 0.4–0.6 cm (*maculata*), 1.2–1.3 × 0.7–0.8 cm (*henryi*); opercula hemispherical-apiculate or rostrate. Flowers May–Sept.

Fruits: Pedicellate, ovoid, sometimes constricted with a short neck, 1–1.4 × 0.9–1.1 cm (slightly larger in *henryi*), woody; disc broad, descending; valves 3 or 4, deeply enclosed. Seeds cymbiform, non-winged, reddish black, hilum ventral.

Wood: Sapwood pale and up to 8 cm wide, very susceptible to *Lyctus* borer attack: heartwood light brown to dark brown, often with a greasy feel, grain often interlocked, moderately coarse-textured, often with very attractive fiddleback figure, kino (gum) veins common, hard, strong, durable to moderately durable; density 745–1080 kg m⁻³; used in mines and for heavy construction as well as for house fabrication, including flooring, and bent work; one of the most suitable Australian timbers for tool handles; produces good logs of pole form and because it has wider sapwood than usual for eucalypts, is one of the favoured species in eastern Australia for preservative-treated poles; has also been used for plywood manufacture.

Climate: Altitudinal range: near sea level to 650 m (*maculata*), 30–120 m (*henryi*); Hottest/coldest months: 25–26°C/4–6°C (*maculata*), 29–31°C/6–9°C (*henryi*); Frost incidence: low to moderate, with up to 60 each year at inland sites (*maculata*), low (*henryi*); Rainfall: 680–1700 mm per year, uniform (*maculata*), 950–1100 mm per year, summer max. (*henryi*).

Distinctive features: Smooth-barked trees with a spotted, colourful bark; inflorescences compound; fruits woody.



Eucalyptus maculata 1. Adult leaves 2. Intermediate leaf 3. Juvenile leaves (non-peltate) 4. Juvenile leaves (peltate) 5. Buds 6. Seedling 7. Fruits 8. Tree, Briar Ridge, N.S.W. 9. Tree, near Helidon, Qld (*E. henryi*) 10, 11. Bark 12. Adult leaf venation

■ Eudesmids

Eucalyptus subgenus *Eudesmia* (R. Br.) L.A.S.
Johnson & K.D. Hill

This group consists of about 20 species ranging in habit from mallees to tall trees up to 40 m in height.

The species are distributed widely in northern Australia and one, Bailey's stringybark (*E. baileyana*) extends down the east coast into northern New South Wales. Several species occupy the arid inland while several others occur in south-western Western Australia outside the wetter areas.

Only a few of the species produce logs of mill size and three of them, namely Darwin stringybark (*E. tetradonta*), *E. baileyana* and Darwin woollybutt (*E. miniata*), are used for construction purposes.

Some species such as illyarrie (*E. erythrocorys*), with its scarlet-capped buds and bright yellow flowers, and scarlet gum (*E. phoenicea*), with its striking orange flowers, are notable ornamentals. A beautiful tree of the deserts with its smooth white bark and mealy white buds, fruits and juvenile leaves is baarla (*E. gongylocarpa*).

Botany

Eudesmia is a generic name originally given to tallerack (*E. pleurocarpa* syn. *E. tetragona*) of south-western Western Australia by Robert Brown in 1814. He considered that this species with its striated opercula, distinct sepals alternating with bundles of stamens (unknown at that time in any other eucalypt) was sufficiently different from *Eucalyptus* that it belonged to another genus linking *Eucalyptus* and *Angophora*. Ferdinand von Mueller later (1864) placed it in *Eucalyptus*. Subgeneric rank was informally applied to *Eudesmia* by Pryor and Johnson (1971) and later formally by Hill and Johnson (1998) which was adopted by Brooker (2000). Earlier, in recognition of the distinctive morphological

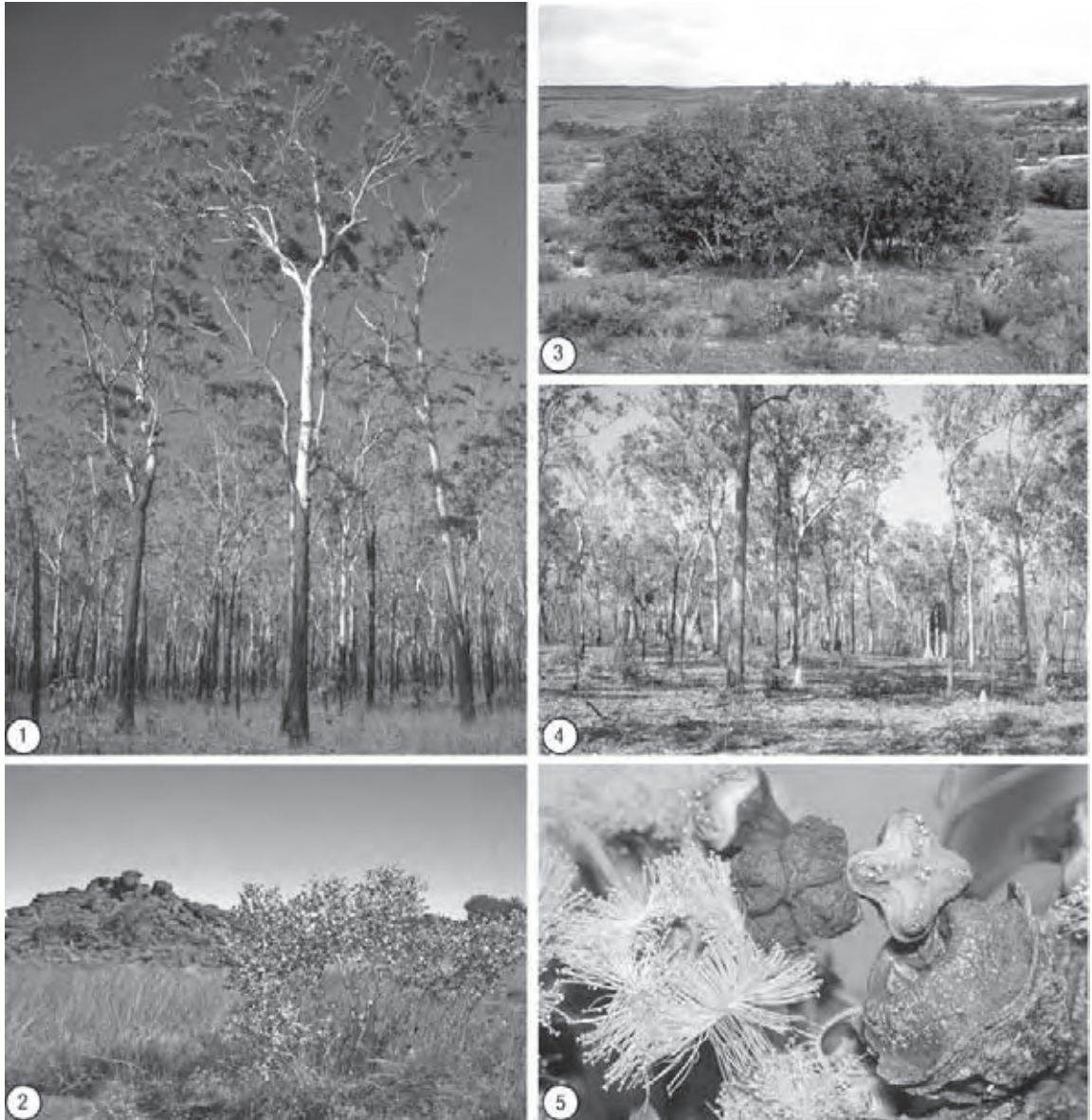
attributes and reproductive isolation of the group, it is notable that Johnson and Briggs (1983) informally erected *Eudesmia* to genus rank. Recent data derived from DNA markers (Steane *et al.* 2002) indicate the eudesmids may well represent a monophyletic group. The name *Eudesmia* comes from the Greek *eu* (well) and *desmos* (a bundle). Several but not all species of the group have the stamens in bundles.

Botanically, the group is rather complex to define. In all species only one operculum is apparent and in some, e.g. Darwin stringybark, a distinct calyx is present in the form of four sepals, which persist in the fruits. In some species the juvenile leaves and stems have stellate trichome clusters.

There is a tendency for the leaves on the mature plants to be pre-adult and in tallerack the mature canopy consists of juvenile leaves only. In some species, e.g. Bailey's stringybark, true adult leaves are formed. Illyarrie provides the curious condition in *Eucalyptus* of producing apparently true, petiolate adult leaves which remain opposite.

Bark characters in the group are variable. The mallees, e.g. blue mallee (*E. gamophylla*), are usually smooth-barked. Darwin stringybark and Bailey's stringybark have bark somewhat similar to the stringybarks of eastern Australia, although the bark of *E. baileyana* is more crumbly than fibrous. Two species, viz. the yellowjackets (*E. lirata* and *E. similis*), have yellow fibrous bark somewhat like yellow bloodwoods.

Bud numbers vary from three in illyarrie to very numerous in scarlet gum. The anthers are usually oblong, versatile and open by longitudinal slits. Fruit shape and size are very variable. Baarla fruits are small and almost globose while those of Darwin woollybutt are barrel-shaped to urceolate and among the largest in the genus. The seeds are also variable, ranging from thin, wafer-like and shortly winged in blue mallee (*E. gamophylla*), to pyramidal in Shark Bay mallee (*E. roycei*) and tending to be cuboid in Darwin woollybutt (*E. miniata*).



Species in subgenus *Eudesmia* occur over a wide geographic range but are absent from south-eastern Australia. They range from mallee shrubs in the temperate south to tall forest trees in tropical north. 1. A pure stand of Darwin woollybutt (*E. miniata*) near Murgarella, N.T. 2. The desert species warilu (*E. gamophylla*), near Mt. Isa, Qld. 3. Northern sandplain mallee (*E. gittensii*), near Northhampton, W.A. 4. A stand of Darwin stringybark (*E. tetradonta*), near Giddy River, N.T. 5. Illyarrie (*E. erythrocorys*) has sculptured, scarlet capped buds, bright yellow flowers and among the largest fruits of any eucalypt.

Baarla Marble Gum, Desert Gum

Eucalyptus gongylocarpa Blakely

Baarla is usually a small tree to 10 m in height, more rarely to 16 m. The trunk may be straight or leaning and divides at a quarter to half tree height. It produces a spreading, moderately sparse crown. The crown is typically as wide as the tree is high and, while only moderately dense, is remarkably good for a tree of the arid zone.

Baarla is distributed widely but sporadically across the arid zone for over 1200 km from the Meekatharra–Sandstone area of Western Australia, south towards Queen Victoria Spring east of Kalgoorlie, and eastwards to Lake Amadeus in the south-west of the Northern Territory. It also occurs in north-western South Australia, north from the Nullarbor Plain.

The habitat of this species is the plains and gentle slopes of inland Australia, and there it sometimes grows on the crests and slopes of sand dunes. The soils are mainly red sands over red and brown hardpan soils or, in the north-east of the occurrence, desert sandhill complex.

Baarla often occurs as pure stands in low open woodlands surrounded by open or low open shrublands. The main vegetation includes *Triodia* (spinifex) and shrubs of the genera *Atriplex* (saltbush), *Maireana* (bluebush) and *Acacia* (wattles). A range of eucalypts may be present (e.g. *E. kingsmillii*, *E. leptopoda*, *E. oldfieldii* and *E. youngiana*).

Related species: Baarla belongs to the heterogeneous subgenus *Eudesmia*, a difficult subgenus to divide into groups of species bearing affinity to each other (Brooker 2000). In its area of occurrence baarla is readily distinguished as a tree with striking smooth white bark, although loose flakes may persist, and by its branchlets, leaves, buds and fruits which are usually pruinose. Trees often hold conspicuous clusters of globose, pruinose fruits. Dense clusters of almost white juvenile leaves at the base or as regrowth on the trunk are also frequently apparent. It does not appear to be closely related to any other species.

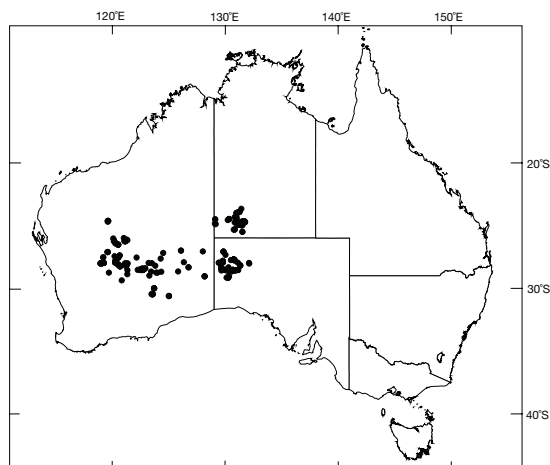
Publication: *Trans. & Proc. Roy. Soc. South Australia* 60, 153 (1936). Type: Camp 60, near Queen Victoria Spring, Western Australia, 24 Sep. 1891, R. Helms.

Names: Botanical—Greek *gongylo* (round), *carpa* (fruit). Common—of Aboriginal origin.

Bark: Smooth, white over the whole tree, often satiny, not powdery. Loose flakes of partly shed, red-brown to yellow-brown bark may persist.

Leaves: Seedling—opposite to subopposite, orbicular to ovate to cordate, 2.3–6 × 1.8–5 cm, pruinose, hairy, leaves usually sessile, rarely shortly petiolate. Juvenile—sessile, opposite, orbicular to ovate to cordate, sometimes with irregular or crenate margins, 2.5–5 × 2–5.5 cm, pruinose, usually pubescent. Adult—opposite to subopposite, oblong-elliptical to lanceolate, 4–7.5 × 0.9–1.7 cm, dull, light green becoming grey-green to bluish green, pruinose, concolorous.

Inflorescences: Simple, axillary, (3)7-flowered; occasionally more than one peduncle in the axils, each slender, terete, 0.8–2 cm long; buds pedicellate, clavate, 0.3–0.5 × 0.3–0.4 cm,



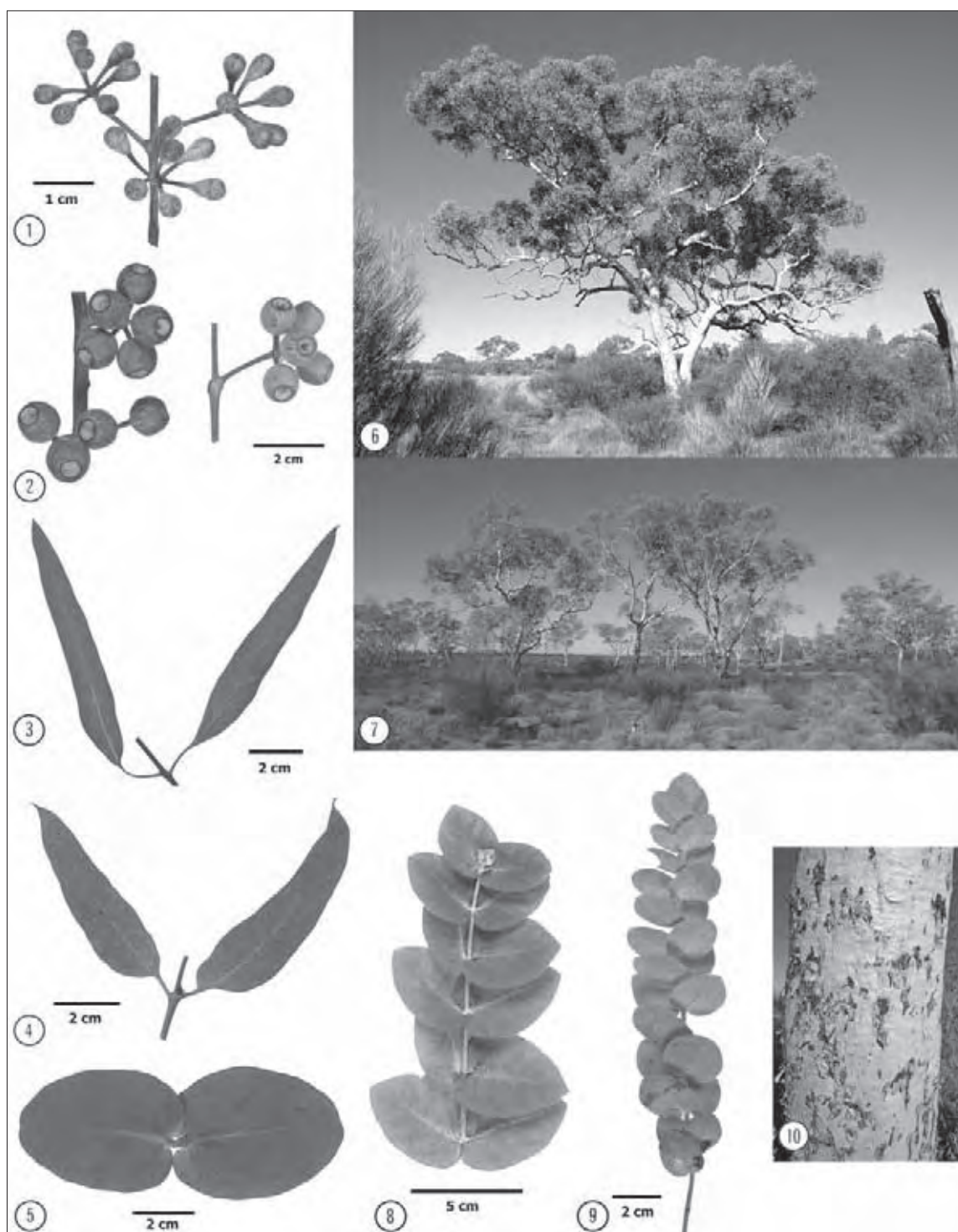
pruinose, minute sepals sometimes seen; opercula hemispherical. Flowers Jan.–Feb.

Fruits: Pedicellate, globose to truncate-globose, 0.6–1.1 × 0.6–1.2 cm, pruinose; disc descending, white; valves 3(4) enclosed. Seeds flattened, saucer-shaped, narrowly flanged, black, hilum ventral.

Wood: Heartwood brown, fine-textured, very heavy with interlocked grain, burns well, density is over 1000 kg m⁻³.

Climate: Altitudinal range: 300–570 m; Hottest/coldest months: 35–38°C/4–7°C; Frost incidence: low to moderate (mean of 1–12 heavy frosts each year); Rainfall: 180–280 mm per year, sporadic and highly variable.

Distinctive features: Strikingly white-barked desert tree; all parts pruinose; juvenile growth conspicuous; buds in 7s; fruits almost spherical. Extremely tolerant of fire, regenerating profusely to produce dense clusters of almost white juvenile leaves at the base or as regrowth on the trunk and branches.



Eucalyptus gongylocarpa 1. Buds 2. Fruits 3. Adult leaves 4. Intermediate leaves 5. Juvenile leaves 6, 7. Tree and stand, near Cosmo Newberry, W.A. 8. Juvenile sprig 9. Seedling 10. Bark

Illyarrie Red-cap Gum, Bookara Gum

Eucalyptus erythrocorys F.Muell.

Illyarrie is usually a small tree or sometimes a straggly mallee 6–8 m tall. The dbh rarely exceeds 30 cm. The trunk is often gently leaning and the crown has sinuous, spreading branches. The crown is often heavy, comprising relatively large, opposite leaves that are often pendulous and notably falcate. Crown branches have smooth cream bark unlike the bole bark which often has some old bark adhering to the trunk in untidy patches.

Illyarrie is endemic to Western Australia where it is restricted to a narrow coastal belt extending from Cockleshell Gully north to Dongara, with an outlier further north in Kalbarri National Park.

This species is restricted to the occurrence of limestone rocks, which outcrop among massive coastal sand dunes. The topography includes the rises and crests of limestone outcrops and interdune swales of dune systems. The soils are calcareous sands and often skeletal.

Illyarrie occurs in pure stands and forms low open woodlands. Surrounding vegetation is known locally as 'kwongan', a species-rich shrubland which contains species from numerous, often endemic genera.

Related species: Illyarrie belongs to the heterogeneous subgenus *Eudesmia*, a difficult subgenus to divide into groups of species bearing affinity to each other (Brooker 2000). Illyarrie is unlikely to be confused with any other eucalypt and is not closely related to any other eudesmid. It is one of the most morphologically unique species in the genus with large ornate buds that have a bright scarlet operculum, a green hypanthium, bright yellow stamens and large, ribbed fruits with a large undulating disc. Illyarrie is placed in subseries *Tetraedrae*, a group characterised by buds with minute sepals, flanged \pm pyramidal seeds and buds and fruit squared in cross-section. Other *Tetraedrae* species are *E. gittinsii*, *E. pleurocarpa*, *E. extrica*, *E. eudesmioides*, *E. conveniens* and *E. roycei*, none of which could be mistaken for illyarrie.

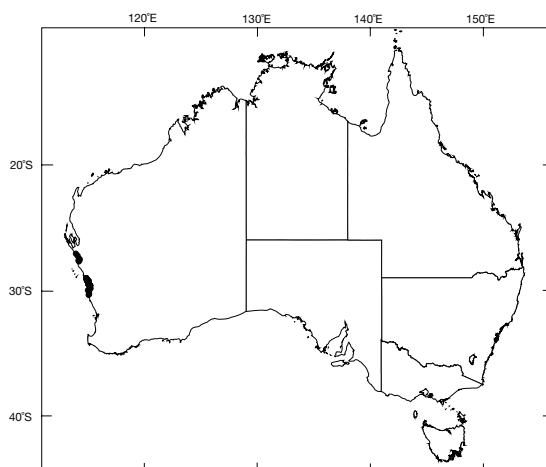
Publication: *Fragm.* 2, 33 (1860). Type: Western Australia: Murchison River, 1859, A. Oldfield.

Names: Botanical—Greek *erythro* (red) and *korys* (helmet), refers to the operculum. Common—of Aboriginal origin.

Bark: Usually smooth to ground level, grey or grey-brown to cream or white, patches of imperfectly shed, yellowish brown bark usual persist along the bole and more commonly at the base.

Leaves: Seedling—opposite, petiolate, ovate to broad-lanceolate to cordate, 4.5–8 \times 2–4.2 cm, glossy green, hairy, margins irregularly toothed due to hairs, base lobed to rounded to truncate. Juvenile—opposite, petiolate, lowest leaves deltoid, broad-lanceolate to ovate to cordate, 5–13 \times 2–6 cm, base lobed to rounded to truncate, green, hairy, glabrescent. Adult—opposite to subopposite, petioles to 3 cm long, lanceolate to falcate, 9–20 \times 1.2–3 cm, green, subglossy, concolorous.

Inflorescences: Simple, axillary, 3-flowered; peduncles to 3 cm long; buds pedicellate, obovoid, 2–3 \times 2–3 cm, hypanthia ridged, green, opercula bright scarlet, flattened with four



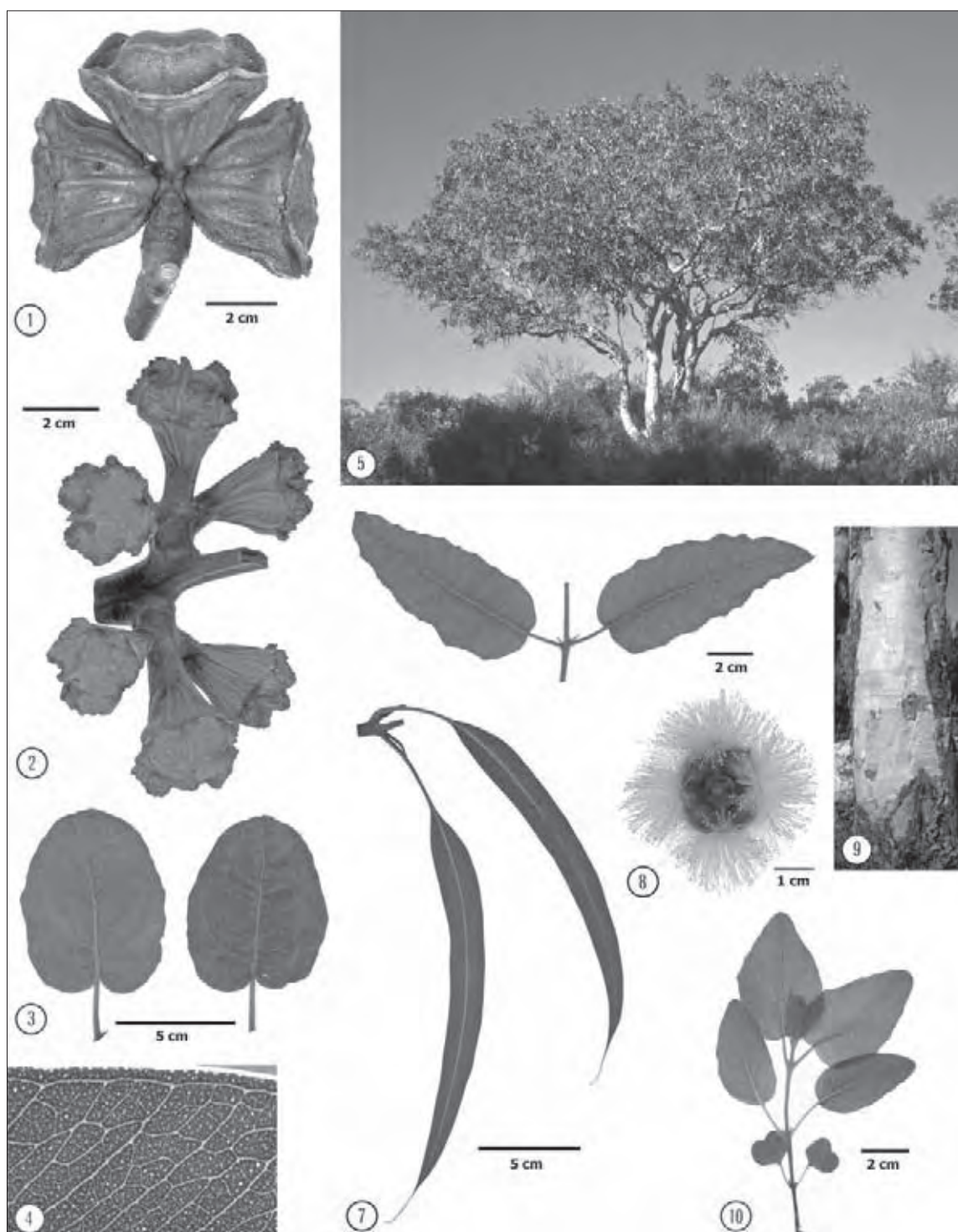
lobes; stamens grouped in four clusters, bright yellow. In natural populations, flowering is unreliable and apparently subject to seasonal conditions. Cultivated trees flower Feb.–Aug.

Fruits: Shortly pedicellate, more or less cuboid, ribbed, 3–4 \times 4–5 cm, with four lobes; disc broad, glossy red when fresh, horizontal or concave or undulating, valves 4, enclosed. Seeds shallowly pyramidal, sides ribbed, dull brown to black, hilum ventral.

Wood: Sapwood pale, heartwood pinkish-brown, very interlocked grain (short-grained), brittle, fine-textured, density 820 kg m⁻³.

Climate: Altitudinal range: 20–80 m; Hottest/coldest months: 32°C/8–9°C; Frost incidence: low; Rainfall: 400–500 mm per year, winter max.

Distinctive features: Small tree with opposite, falcate adult leaves; branchlets conspicuously rectangular; buds large, in 3s with a bright scarlet ornate opercula and a green hypanthia; flowers with bright yellow stamens; fruits large, woody, ribbed, disc large undulating, red when new. Commonly cultivated as a street tree in Perth and many towns in regional temperate Australia.



Eucalyptus erythrocorys 1. Fruits 2. Buds 3. Juvenile leaves 4. Adult leaf venation 5. Tree, near Dongara, W.A.
6. Coppice/intermediate leaves 7. Adult leaves 8. Plan view of flower showing stamens in bundles of four
9. Bark 10. Seedling

Darwin Stringybark Stringybark (N.T., W.A.), Messmate (northern Qld, W.A.)

Eucalyptus tetradonta F. Muell.

Darwin stringybark is commonly 15–25 m in height and up to 0.6 m dbh, though under optimum conditions trees attain 40 m in some areas, and 1 m dbh. The trunk is generally straight and from half to two-thirds of the total height. The crown is somewhat open and the branches relatively straight.

Darwin stringybark is widely distributed in the Northern Territory north of 17°S latitude and in the adjacent Kimberley region of Western Australia. There is also an extensive occurrence in the Cape York Peninsula area of northern Queensland from west of The Lynd, Cooktown and the Atherton Tableland northwards. It extends south to Forsyth with occurrences near Normanton and further westwards and a southern outlier occurs north of Prairie.

This species usually occurs on country of low relief, but also extends to low tablelands in the inland regions. Best growth is attained on moderately deep, well-drained sandy soils. It also occurs on lateritic gravels, loams, clays and shales.

Darwin stringybark and Darwin woollybutt (*E. minata*) are the two most common eucalypts in northern areas of the Northern Territory and they frequently occur together in open forests or woodlands. Other associates of Darwin stringybark are various bloodwoods and ghost gums (*E. polycarpa*, *E. clarksoniana*, *E. terminalis*, *E. dichromophloia*, *E. dunlopiana*, *E. nesophila*, *E. tessellaris*, *E. confertiflora*), weeping box (*E. patellaris*), cypress pine (*Callitris intratropica*), Cooktown ironwood (*Erythrophleum chlorostachys*) and various species of *Acacia*, *Grevillea* and *Terminalia*.

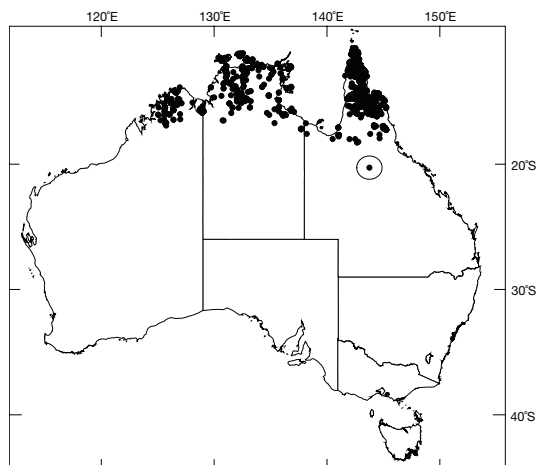
Related species: Darwin stringybark belongs to the heterogeneous subgenus *Eudesmia*, a difficult subgenus to divide into groups of species bearing affinity to each other (Brooker 2000). In its area of natural occurrence it should not be confused with any other species with its tall straight habit, stringy bark, large adult leaves, conspicuous ovate, pendulous juvenile leaves and the relatively large fruits in threes and with sepals around the rim.

Publication: *J. & Proc. Linn. Soc. Bot.* 3, 97 (1859). Type: Near mouth of Victoria River, Northern Territory, Sept. 1855, F. von Mueller.

Names: Botanical—Greek *tetra* (four), *odontos* (tooth), referring to the sepals. Common—refers to the Darwin region and to the bark.

Bark: Rough, persistent to the smaller branches, long fibred, compact, stringy, grey, thick.

Leaves: Seedling—opposite to subopposite, petiolate, lanceolate at first, later becoming much broader, 6–17 × 1.5–3.5 cm, dull greyish green, concolorous. Juvenile—opposite or subopposite, petiolate, ovate to broad-lanceolate, pendulous, 15–30 × 3.5–10 cm, dull greyish green, concolorous. Intermediate—opposite or subopposite, petiolate, broad-lanceolate to lanceolate, 14.5–32 × 2.8–6.5 cm, dull greyish green, concolorous.



Adult—opposite or subopposite, petiolate, lanceolate to narrow-lanceolate, or falcate, 11–19 × 1.4–3 cm, dull greyish green, concolorous; stems are usually square or rectangular in cross-section.

Inflorescences: Simple, axillary, 3-flowered; peduncles more or less terete, slightly angular or sometimes distinctly flattened, often curved, 0.4–1.4 cm long; pedicels distinctly angular, that for the central bud usually flattened, 0.1–0.7 cm long, though sometimes absent; buds ovoid or somewhat pyriform, ribbed, 0.8–2.5 × 0.6–1.2 cm, with 4 prominent teeth (sepals); opercula hemispherical or subglobose, either smooth or prominently wrinkled (due to the sutures of the more or less fused petals of which the opercula are composed). Some specimens from the Laura area in north Queensland have more prominently beaked, distinctly ribbed (petal sutures) opercula. Flowers Jun.–Sept.

Fruits: Sessile or pedicellate, ribbed, cupular to more or less campanulate, i.e. flared at the rim, 1.3–2.2 × 1–1.4 cm, with 4 distinct (sometimes extremely prominent) sepals and a prominent, ascending operculum scar; disc broad, descending; valves 3, enclosed or to just above rim level. Seeds pyramidal though very irregular, ribbed on ventral side with narrow hyaline wing around edge, grey-black, hilum ventral.

Wood: Sapwood yellow or white, fairly wide; heartwood pale reddish brown, fairly hard, moderate texture, moderately durable, fissile; density is in the range 1040–1150 kg m⁻³; sometimes attacked by termites, used for poles and general house construction and by Aboriginal people to make didgeridoos.

Climate: Altitudinal range: near sea level to 840 m; Hottest/coldest months: 31–39°C/12–22°C; Frost incidence: low; Rainfall: 700–1500 mm per year, summer max.

Distinctive features: A grey stringybarked tree; 3-flowered inflorescences; buds and fruits with 4 prominent teeth (sepals); leaves dull greyish green and opposite or subopposite at all stages; conspicuous, broad, pendulous juvenile leaves.



Eucalyptus tetradonta 1. Adult leaves 2. Intermediate leaf 3. Juvenile leaf 4. Seedling 5. Fruits 6. Buds at early stage of development 7. Mature buds 8. Tree, south of Katherine, N.T. 9. Bark 10. Adult leaf venation

Bailey's Stringybark

Eucalyptus baileyana F. Muell.

Bailey's stringybark at its best is of good form, attaining 40 m in height and 1 m dbh. More commonly it is a medium-sized tree, often only 10–25 m in height, usually of good form but sometimes straggly.

Bailey's stringybark is distributed in a narrow coastal belt within 80 km of the sea from Coffs Harbour in northern New South Wales to around Brisbane in Queensland. Farther north its distribution is sporadic and more inland. It occurs as far north as the Blackdown Tableland and Isla Gorge National Park, also west of Eidsfold, south of Mundubbera and north-east of Toowoomba in Queensland.

This species is found on coastal lowlands, small ridges, and hills, and for the inland occurrences, on high tablelands. On the coastal lowlands it grows on poor sandy soils, often derived from sandstones, or on poor shale loams. The amount of clay in the subsoil is variable and the sites are nearly always well drained.

This species occurs mostly in open forests often associated with needlebark stringybark (*E. planchoniana*), Gympie messmate (*E. cloeziana*), lemon-scented gum (*E. citriodora*) and bloodwoods (*E. gummifera* and *E. intermedia*). It attains its best development in high quality forest on the Blackdown Tableland.

Related species: Bailey's stringybark belongs to the heterogeneous subgenus *Eudesmia*, a difficult subgenus to divide into groups of species bearing affinity to each other (Brooker 2001). In its area of natural occurrence, it can be recognised by the grey, fibrous, crumbly rough bark over the whole trunk and branches, the strongly discoloured leaves, the urceolate fruit, which superficially resemble a bloodwood fruit, and by the poor sites on which it occurs.

Publication: *Fragm.* 11, 37 (1878). Type: Moreton Bay, Queensland, Jun. 1878, F.M. Bailey.

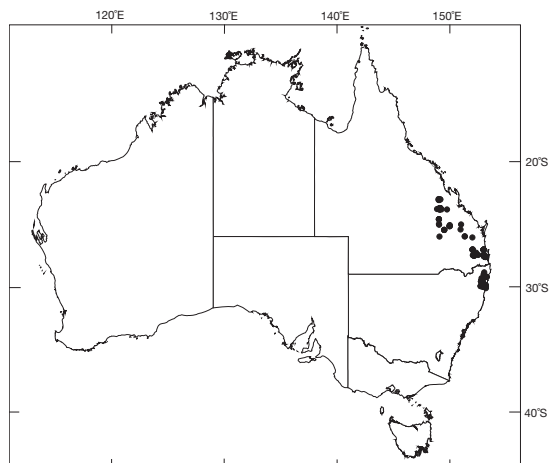
Names: Botanical—after the collector of the type.

Common—also after the collector, and refers to the texture of the bark.

Bark: Rough and persistent on the trunk and larger branches, with short needle-like fibres, somewhat stringy in appearance, thick, fairly hard, reddish brown underbark weathering to grey or black, contains a large amount of kino.

Leaves: Leaves at all stages are strongly discoloured, dark green above and pale below. Seedling—opposite for a few pairs, petiolate, ovate (for most populations), 8–13 × 4–7.5 cm; lanceolate (at least for the Blackdown population), 5–11 × 1–2.2 cm; stems, petioles, leaf veins densely setose with stellate hairs. Juvenile—alternate, petiolate, ovate to lanceolate, sometimes cordate, 13–18 × 3.5–9 cm; stellate hairs becoming fewer, though this character varies with provenance. Intermediate—alternate, petiolate, broad-lanceolate, 13–21 × 3–5 cm, glabrous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, or falcate, 8–15 × 1–2.5 cm, tapering to a long, fine point.

Inflorescences: Simple, axillary, 7-flowered; peduncles angular to flattened, 1.5–2.7 cm long; pedicels 0.2–1.1 cm long;



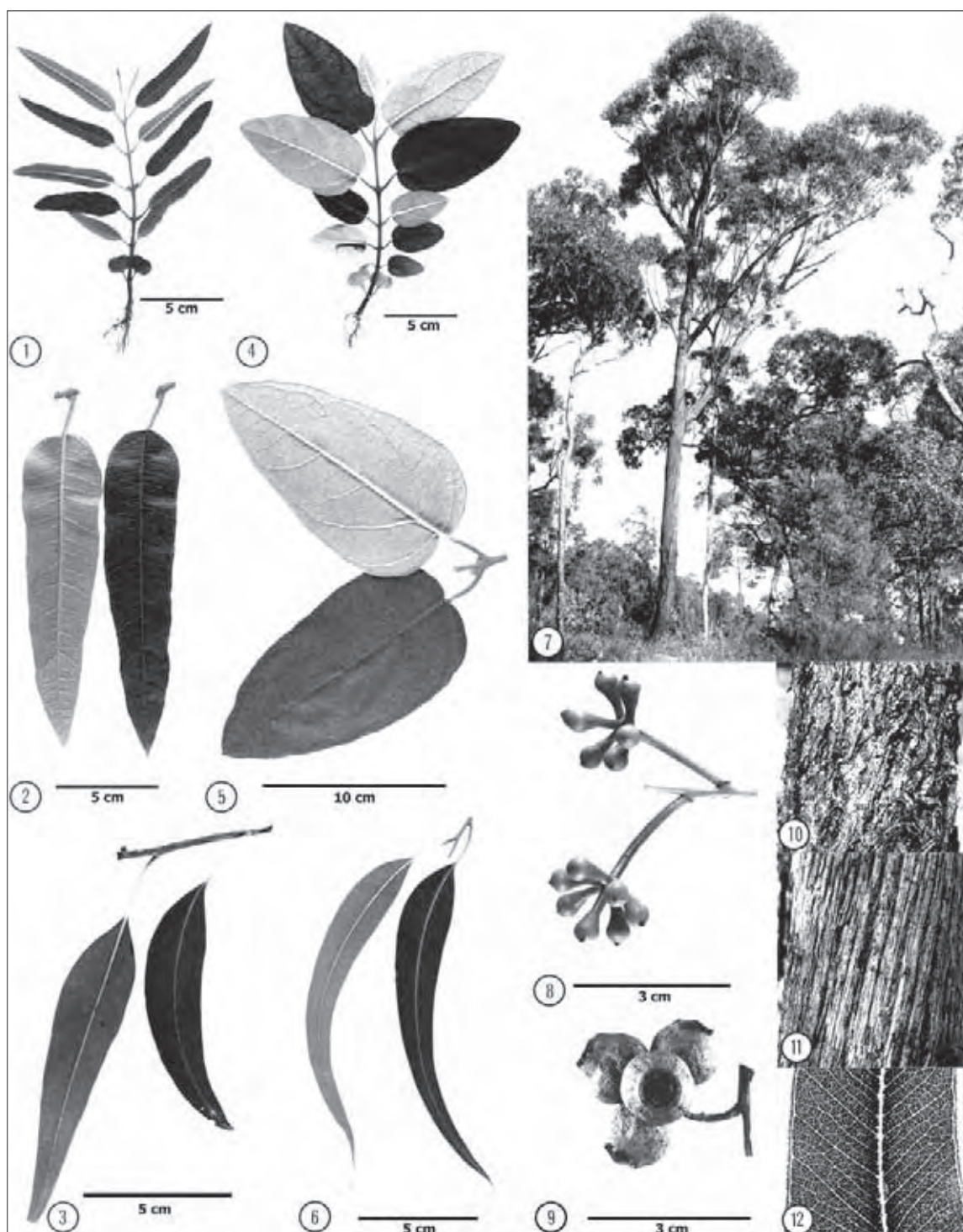
buds pedicellate, clavate to pyriform, 0.6–0.8 × 0.3–0.4 cm, often with 2 faint ribs extending up the hypanthium from the slightly angular pedicels; opercula hemispherical-apiculate. Flowers Nov.–Jan.

Fruits: Pedicellate, globose or ovoid, slightly urceolate, often broader than long, 0.8–1.4 × 0.8–1.6 cm; disc broad, descending; valves 3, broad and short, to rim level or very slightly exerted from a relatively small orifice. Rim of fruit with 4 raised lobes, walls sometimes ribbed. Seeds flattened-elliptical, grey-black, hilum ventral.

Wood: Heartwood light grey when freshly sawn but darkening to deep pinkish brown, texture intermediate, interlocked grain, strong, very durable; density 720–905 kg m⁻³; used for fencing material, either split or in the round, poles and general construction.

Climate: Altitudinal range: near sea level to 890 m; Hottest/coldest months: 29–34°C/5–10°C; Frost incidence: low (except a few each year at high elevation inland sites); Rainfall: 700–1500 mm per year, summer max.

Distinctive features: Grey, persistent, fibrous bark; strongly discoloured leaves at all stages; inflorescences 7-flowered; buds and fruits strongly pedicellate, central bud often conspicuously longer than lateral ones; fruit rim 4-lobed and urceolate, superficially resembling a bloodwood fruit; juvenile leaves and stems with many stellate hairs.



Eucalyptus baileyana 1. Seedling, Blackdown Tableland, Qld 2. Juvenile leaves, Blackdown Tableland, Qld 3. Intermediate leaves 4. Seedling, north of Woolgoolga, N.S.W. 5. Juvenile leaves, north of Woolgoolga, N.S.W. 6. Adult leaves 7. Tree, Blackdown Tableland, south-east of Blackwater, Qld 8. Buds 9. Fruits 10. Bark of young tree 11. Bark of mature tree 12. Adult leaf venation

Darwin Woollybutt Woollybutt

Eucalyptus miniata Cunn. ex Schauer

Darwin woollybutt, like its common associate Darwin stringybark (*E. tetradonta*), is one of the larger eucalypts of the Northern Territory. It is usually 15–25 m in height and up to 0.6 m dbh but attains 30 m in height and 1 m dbh under optimum conditions. The trunk is usually of reasonable form and more than half the total height.

Darwin woollybutt is widely distributed in the Northern Territory north of Larrimah, extending westwards into the Kimberley region of Western Australia. To the east it occurs sparsely along the south of the Gulf of Carpentaria to west of Burketown, but becomes more common in the southern part of Cape York Peninsula (south from Maitland Downs), Queensland, west of Mareeba towards Georgetown, extending as far south as the Pentland district, with an isolated occurrence at Lake Webb.

Darwin woollybutt usually occurs on country of low relief, but also extends to low tablelands in the inland region. It is most commonly found on soils of lateritic or sandy nature.

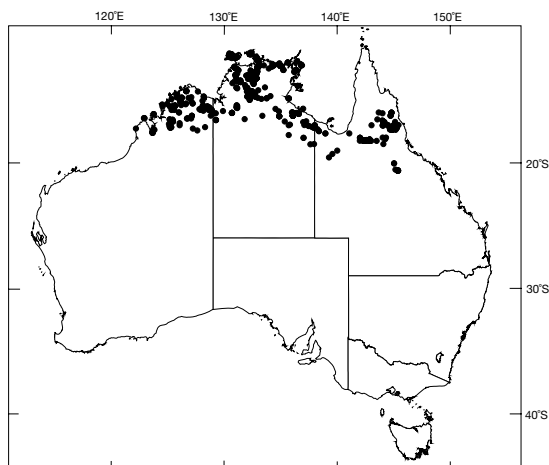
This species is generally found in open forests or woodlands often associated with Melville Island bloodwood (*E. nesophila*), Darwin stringybark (*E. tetradonta*), scarlet gum (*E. phoenicea*), smooth-stemmed bloodwood (*E. bleeseri*), Clarkson's bloodwood (*E. clarksoniana*) and long-fruited bloodwood (*E. polycarpa*).

Related species: Darwin woollybutt belongs to the heterogeneous subgenus *Eudesmia*, a difficult subgenus to divide into groups of species bearing affinity to each other (Brooker 2001). Kakadu woollybutt (*E. gigantangion*) is closely related and differs in having narrower leaves, non-pruinose, ribbed buds, larger fruit and is restricted to the Arnhem Land escarpment in Northern Territory. Apart from this species, Darwin woollybutt should not be confused with any other species with the dark brown or reddish brown, loosely fibrous rough bark over part or most of the trunk, conspicuously white above, and light green leaves. Scarlet gum (*E. phoenicea*) shares the bright orange flowers but is a mallee or small tree with many more flowers to the unit inflorescence and often occurs on stony ridges, compared to the predominantly plains occurrences of Darwin woollybutt. Eastern populations of Darwin woollybutt in north Queensland were described as *E. chartaboma* by Nicolle (2000), based mainly on their flaky bark.

Publication: In *Walper's Repert. Bot. Syst.* 2, 925 (1843). Type: Hunter's River, York Sound, Western Australia, 10 Sep. 1820. A. Cunningham 241.

Names: Botanical—Latin *miniatus* (Saturn-red; flame scarlet), a questionable allusion to the flowers (the flower colour is orange). Common—woollybutt refers to the lower bark.

Bark: Rough and persistent for a quarter to half the tree height, spongy, fissured, short-fibred and somewhat stringy or flaky-papery forming small thin scales, grey, rusty red or slightly yellowish; shed from the upper part of trunk and branches in papery flakes, leaving the surface smooth and white, clearly contrasting with the darker basal bark.



Leaves: Seedling—opposite for several pairs then alternate, petiolate, ovate, 4.5–7.5 × 1.8–3.3 cm, green, discolorous. Juvenile—alternate, petiolate, ovate, 8–12 × 3.5–5 cm, green, discolorous. Many stellate hairs present on stems, petioles and leaf veins in seedling and juvenile stages. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 10–16 × 4–6 cm, green, discolorous. Adult—alternate, petiolate, broad-lanceolate to narrow-lanceolate, 9–16 × 1–3.5 cm, light green, discolorous.

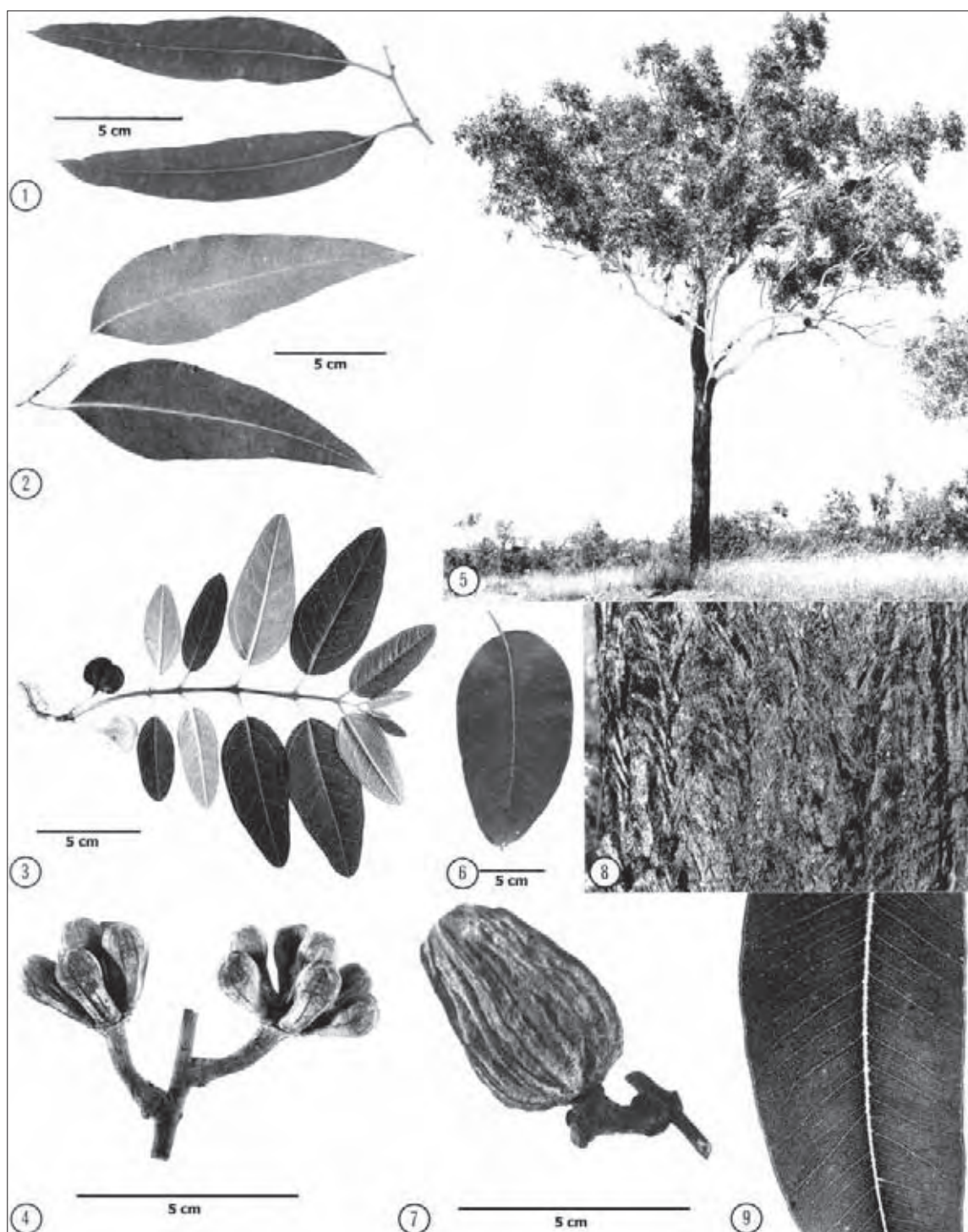
Inflorescences: Simple, axillary, 7-flowered; peduncles stout, terete to slightly angled, 1.2–3.5 cm long, often down-curved; pedicels absent or very short; buds ovoid or clavate, 1.1–2.3 × 0.7–1.1 cm, faintly striated to strongly ribbed on hypanthia and opercula, pruinose; opercula hemispherical to conical; filaments orange. Flowers May–Jul.

Fruits: Very shortly pedicellate or more often sessile, ovoid and usually contracted at the top, 3–6.5 × 1.7–5 cm, faintly to very prominently ribbed; disc broad, descending; valves 3, deeply enclosed. Seeds truncated-pyramidal or cuboid, grey-black, hilum ventral.

Wood: Heartwood red to red-brown often with purplish tinge, very hard, grain interlocked and often wavy, texture is moderately fine to intermediate, subject to termite attack; density 1035–1100 kg m⁻³; used occasionally for local construction and as round material for temporary fencing; like many species with similar distribution it is rarely without serious internal defect.

Climate: Altitudinal range: near sea level to 480 m; Hottest/coldest months: 32–39°C/12–22°C; Frost incidence: low; Rainfall: 600–1500 mm per year, summer max.

Distinctive features: A more or less half-barked tree with spongy, subfibrous, grey, red-brown or slightly yellowish lower bark, upper trunk and branches smooth, white; peduncles stout; 7-flowered unit inflorescences; buds ribbed, pruinose; flowers conspicuous, large, orange; fruits very large, woody, generally with well-developed ribs; all leaves discolorous; many stellate hairs in the seedling and juvenile leaf stages.



Eucalyptus miniata 1. Adult leaves 2. Intermediate leaves 3. Seedling 4. Buds 5. Tree, near Katherine, N.T.
6. Juvenile leaf 7. Fruit 8. Bark 9. Adult leaf venation

Scarlet Gum Ngainggar

Eucalyptus phoenicea F. Muell.

Scarlet gum is a small tree or mallee, usually 6–12 m in height and up to 0.3 m dbh. The trees of the disjunct Queensland occurrence are typically taller, have better form and reach 25 m tall with trunks exceeding half the tree height. Elsewhere the trunk is typically of poor form and rarely attains half the tree height; often within a metre or so of ground level it divides into two or more stems, which, in turn, divide to form the framework of a moderately large but somewhat open crown.

Scarlet gum occurs in the northern part of the Northern Territory, especially in the Darwin–Pine Creek–Victoria River region, and the scarps of Arnhem Land, and in Western Australia, where it is mainly found within 160 km of Wyndham. In Queensland it is known only from a small area north-west of Cooktown.

The topography where scarlet gum grows varies from steep rocky slopes, for example the scarps of Arnhem Land, to gently sloping, stony terrain. The soils are poor and include both skeletal and sandy types, with granites and sandstones as the common parent rocks.

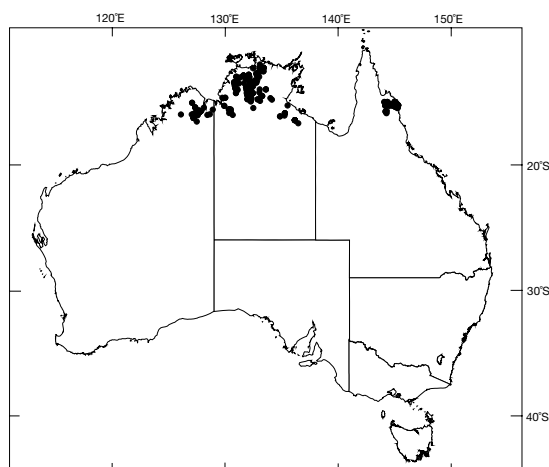
Scarlet gum grows in open woodlands or forests, sometimes as the main species but usually in association with other eucalypts. These include Darwin woollybutt (*E. miniata*), Darwin stringybark (*E. tetradonta*), variable-barked bloodwood (*E. dichromophloia*), ghost gum (*E. aparrerinja*) and tropical red gums from the '*E. alba* group'.

Related species: Scarlet gum belongs to the heterogeneous subgenus *Eudesmia*, a difficult subgenus to divide into two groups of species bearing affinity to each other (Brooker 2001). In its area of natural occurrence it should not be confused with any other species with the yellowish or yellow-grey, loosely fibrous rough bark over the whole trunk, and up to more than 20 buds per inflorescence. Its bright orange flowers are similar to Darwin woollybutt (*E. miniata*), which is a small to medium-sized tree with rough bark over part of the trunk, and with 7 flowers per unit inflorescence and much larger fruits. Trees of scarlet gum from the disjunct Cooktown occurrence in Queensland have distinct bark differences and may warrant taxonomic reappraisal. Seppelt Range rustyjacket (*E. ceracea*) is related to scarlet gum but differs in that mature trees have juvenile opposite, amplexicaul, pruinose foliage and is restricted to the Kimberley in Western Australia.

Publication: *J. & Proc. Linn. Soc. Bot.* 3, 91 (1859). Type: 'Victoria River, near the Main Camp', May 1856, F. von Mueller; 'Ranges near the Fitzmaurice River', Oct. 1856, F. von Mueller.

Names: Botanical—Latin *phoeniceus* (bright red, scarlet), a questionable allusion to the flowers (the flower colour is orange). Common—also a questionable reference to the flower colour.

Bark: Rough and persistent on the trunk and large branches, yellow, flaky-fibrous to scaly, smaller branches smooth, cream or white, in trees from its main area of occurrence; lower bark stringy (not flaky-fibrous to scaly), greyish and with very



little smooth upper bark, in trees from the Cooktown occurrence.

Leaves: Seedling—opposite, petiolate, ovate to almost orbicular, 4–7 × 2–5 cm, green, discolorous; stellate hairs on stems and leaves. Juvenile—alternate, petiolate, ovate, 6–12 × 3–6 cm, green, discolorous; setose at first, later leaves becoming glabrous. Intermediate—alternate, petiolate, broad-lanceolate, 10–14 × 2.5–3 cm, grey-green, concolorous. Adult—alternate, petiolate, lanceolate, 8–12 × 1.2–2 cm, light green to yellowish green or grey-green, concolorous.

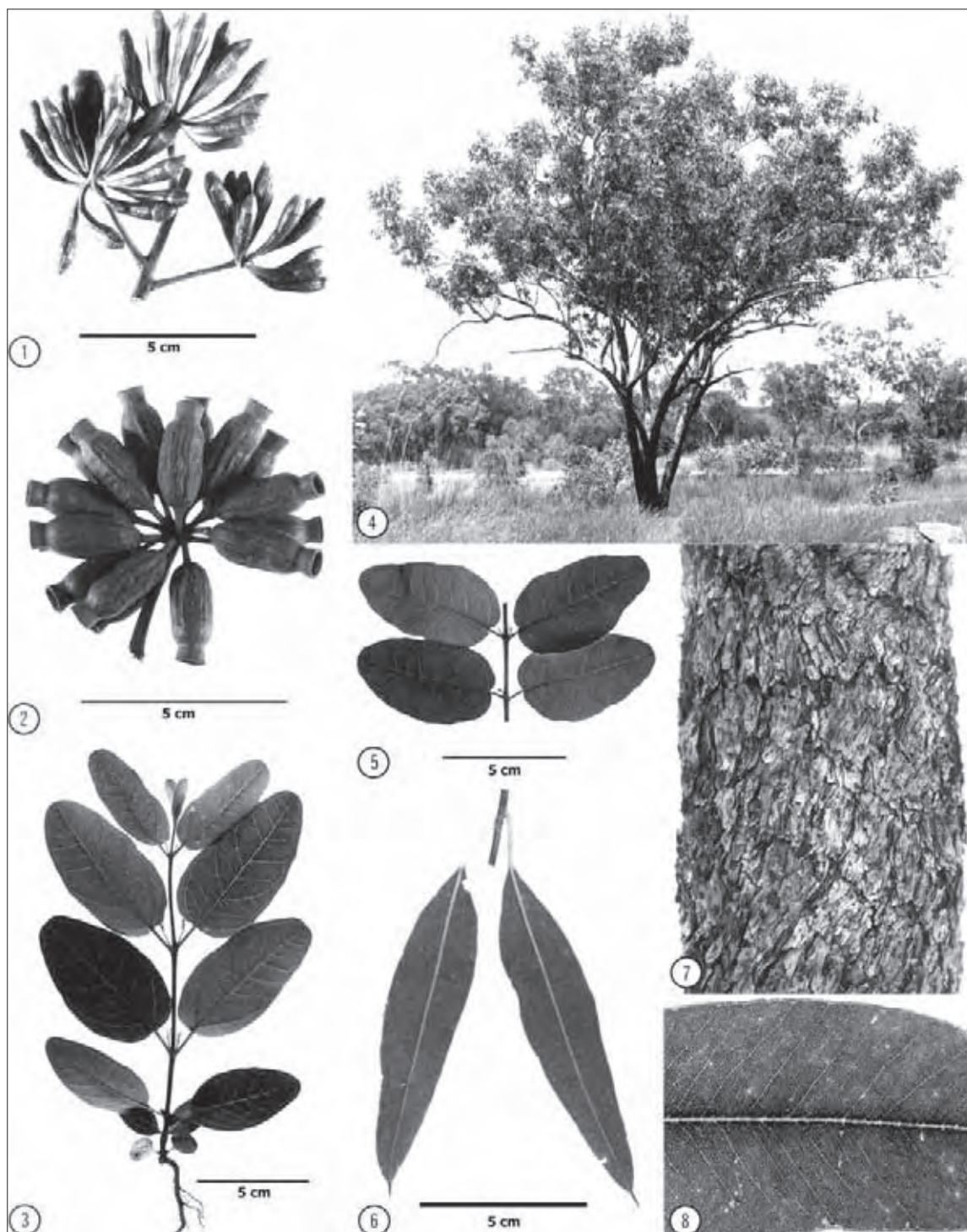
Inflorescences: Simple, axillary, many-flowered (often more than 20); peduncles terete to angular, 1.6–3.3 cm long; pedicels 0.4–1.5 cm long; buds clavate, 0.9–1.8 × 0.4–0.7 cm, hypanthia faintly striated; opercula hemispherical to conical; filaments orange. Flowers Jan.–May.

Fruits: Pedicellate, subcylindrical, elongated, rounded at the base and slightly urceolate at the top, 1.9–3 × 0.9–1.3 cm, ribbed; disc very broad, steeply descending; valves 2, deeply enclosed. Seeds flattened-elliptical, grey-black, hilum ventral.

Wood: Sapwood wide; heartwood dark reddish brown, grain interlocked with a fine, even texture, density 985–1015 kg m⁻³, trunk usually piped. The species is a popular ornamental and is adaptable to poor, stony sites.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 33–39°C/13–19°C; Frost incidence: low; Rainfall: 700–1500 mm per year, summer max.

Distinctive features: Small tree or mallee in main area of occurrence, or tree to 25 m tall in Queensland; bark yellowish and flaky on trunk and larger branches except greyish, stringy, extending to smallest branches in Queensland; many-flowered inflorescences; orange flowers; elongated-urceolate fruit with 2 valves. The species is often regarded as one of the more attractive eucalypts of northern Australia, due to its conspicuous orange flowers.



Eucalyptus phoenicea 1. Buds 2. Fruits 3. Seedling 4. Tree, near Katherine, N.T. 5. Juvenile leaves 6. Adult leaves 7. Bark 8. Adult leaf venation

Yellow Tingle

Eucalyptus guilfoylei Maiden

Yellow tingle is a medium-sized to tall tree, up to 35 m in height and 1 m dbh. In general appearance it is rather like red tingle (*E. jacksonii*) and Rate's tingle (*E. brevistylis*), but does not attain the large dimensions of these species.

Yellow tingle, as is typical of many well-known Western Australian eucalypts, has a very limited natural occurrence. It is found in a comparatively small area, which extends along the south coast in the vicinity of the Deep and Frankland Rivers and Nornalup Inlet, west of Albany, in the extreme south-west of the State. It overlaps the distribution of red tingle.

This species grows on slopes and ridges of undulating and hilly country near the sea. Best development is on deep red loamy soils over deep subsoils that have high clay content, but it will grow on lighter loams derived from schists and granites. The more fertile soils are usually derived from basalts and dolerites.

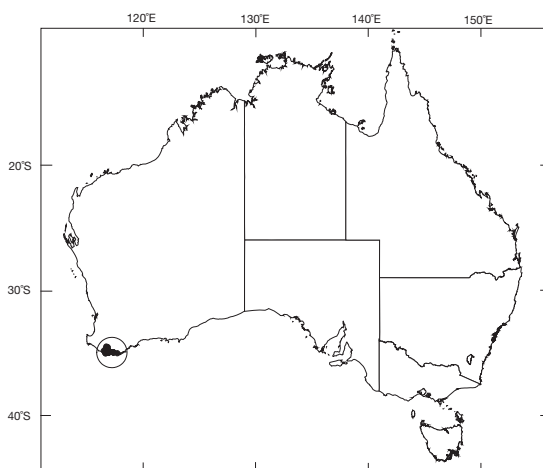
Yellow tingle is nowhere the dominant species nor is it found in extensive stands, but usually occurs in tall open forests as scattered trees where other species are dominant, as in the southern range of karri (*E. diversicolor*). It may also be associated with marri (*E. calophylla*) and the more restricted red tingle (*E. jacksonii*).

Related species: Yellow tingle is not closely related to any other species and belongs to the monotypic subgenus *Cruciformes* (Brooker 2000). In the past it has been classified with species of section *Latoangulatae* (= *Transversaria* Pryor and Johnson 1971), sharing the strongly discoloured adult leaves, but has little else in common. It is easily distinguished by the adult leaves and most particularly by the inflorescences in terminal panicles, a character only seen in *Symphyomyrtus* in the quite unrelated section *Adnataria* (boxes and ironbarks). The butterfly-shaped anthers of yellow tingle are unique in the genus. In the field, its non-buttressed base of the trunk and petiolate seedling leaves distinguishes it from Rate's tingle (*E. brevistylis*), while its yellow wood also distinguishes it from red tingle (*E. jacksonii*). Both of these co-occurring species are from subgen. *Eucalyptus*. The monophyletic status of yellow tingle was supported by DNA markers in a study by Steane *et al.* (2002).

Publication: *J. W. Austral. Nat. Hist. Soc.* 3, 180 (1911). Type: Denmark, Western Australia, Mar. 1905, A. Murphy.

Names: Botanical—honours W.R. Guilfoyle (1840–1912), one-time Director of the Botanic Gardens in Melbourne. Common—refers to the wood colour and 'tingle' is of Aboriginal origin.

Bark: Rough and persistent on the trunk and most of the branches, fibrous, thick, tight, not deeply furrowed, brown to grey-brown.



Leaves: Seedling—opposite for up to 10 pairs then alternate, generally petiolate (though some sessile for a few pairs), elliptical to ovate, 5–11 × 2.7–6 cm, green, discoloured. Juvenile—alternate, petiolate, elliptical to ovate, 11–13 × 5.5–7 cm, green, discoloured. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 10–16 × 3–6 cm, green, discoloured. Adult—alternate, petiolate, broad-lanceolate to lanceolate, 9.5–13 × 1.7–3.5 cm, green, discoloured.

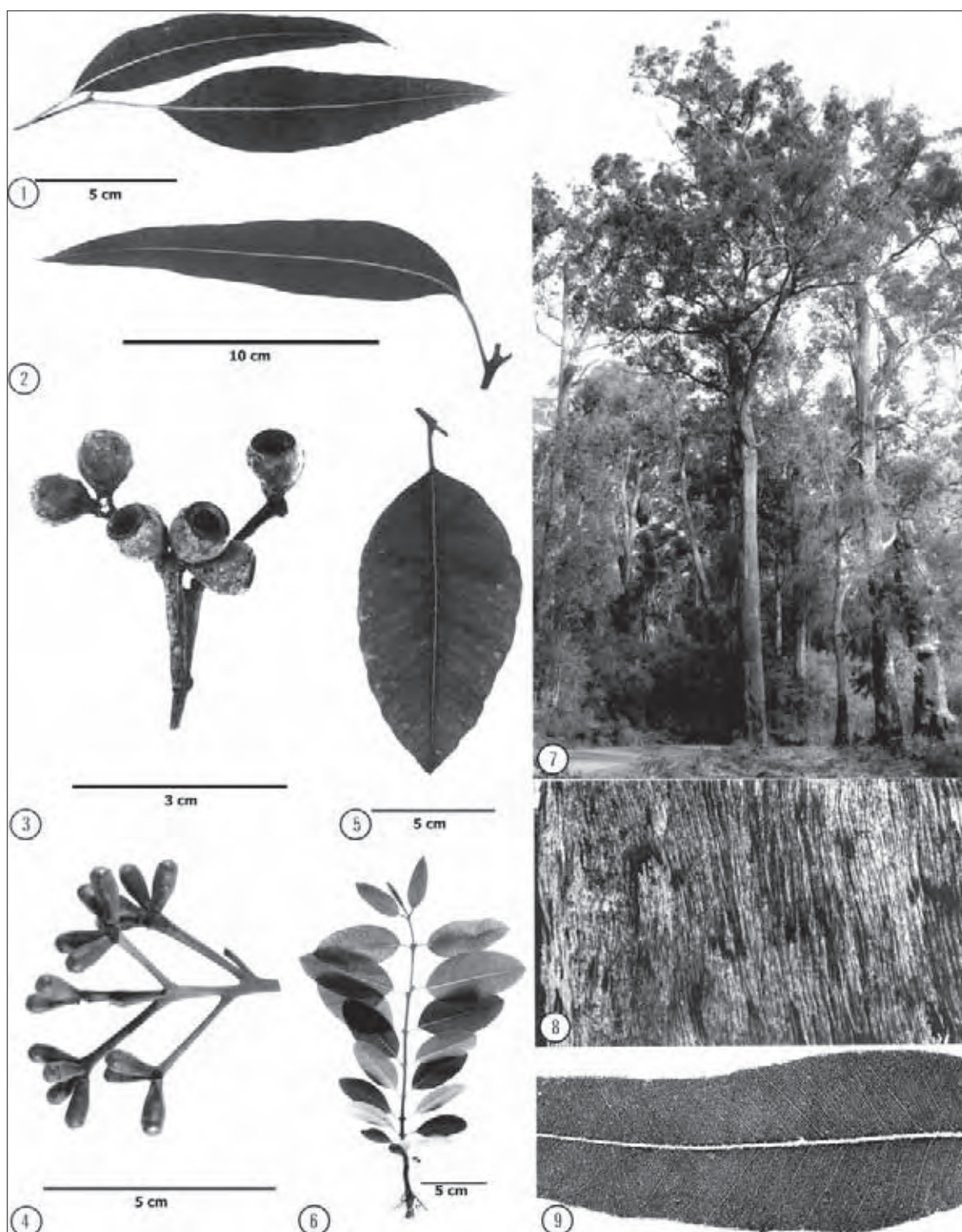
Inflorescences: Axillary and terminal panicles, 7-flowered; peduncles flattened, 1–2 cm long; pedicels absent, or to 0.3 cm long and angular; buds clavate, 0.7–0.8 × 0.3–0.4 cm, with ribbed hypanthia; opercula hemispherical. Flowers Dec.–Jan.

Fruits: Sessile to shortly pedicellate, pyriform to truncate-globular, 0.7–1 × 0.7–1 cm, sometimes ribbed; disc relatively narrow, level to descending; valves 3 or 4, about rim level or slightly enclosed. Seeds flattened and saucer-shaped, brown to yellow-brown, hilum ventral.

Wood: Heartwood yellow-brown, hard, straight-grained and durable; density about 950 kg m⁻³; used for railway sleepers, poles and bridge construction and milled for flooring and building scantlings.

Climate: Altitudinal range: near sea level to 180 m; Hottest/coldest months: 26°C/7°C; Frost incidence: low; Rainfall: 1100–1300 mm per year, winter max.

Distinctive features: Trunk not buttressed as in the other tingles; bark fibrous, persistent; wood yellow; all leaves discoloured; inflorescences paniculate and mostly terminal; stems and buds square in section; opercula hemispherical; fruits usually with some ribs continuous from the pedicels.



Eucalyptus guilfoylei 1. Adult leaves 2. Intermediate leaf 3. Fruits 4. Buds 5. Juvenile leaf 6. Seedling 7. Stand, near Walpole, W.A. 8. Bark 9. Adult leaf venation

■ *Symphyomyrtus* (Gums, Boxes, Ironbarks, Mallees, Mallets)

Eucalyptus subgenus *Symphyomyrtus* (Schauer)
Brooker

This group is the largest in the genus *Eucalyptus* and consists of about 450 species. A great variety of forms is represented varying from almost decumbent shrubs to giant trees second only in height among hardwoods to mountain ash (*E. regnans*) of subgenus *Eucalyptus*.

The species are distributed over the whole of continental Australia and Tasmania, and a few extend to New Guinea, Timor and some Indonesian islands, at northern parts of the Australian tectonic plate. Kamarere (*E. deglupta*) is the only species to extend north of the equator (9°N) on Mindanao in the Philippines. Consequently the range of adaptation within the subgenus is extremely wide. Some species occupy the most arid areas, most are adapted to more humid zones whether temperate or tropical, while several occur in the subalpine and cold regions of the mainland and Tasmania.

Some species are confined to single small areas, for example, Pokolbin mallee (*E. pumila*), while others, notably river red gum (*E. camaldulensis*), occur widely over mainland Australia.

Several species of *Symphyomyrtus* including *E. camaldulensis*, Tasmanian blue gum (*E. globulus*), flooded gum (*E. grandis*), swamp mahogany (*E. robusta*) and manna gum (*E. viminalis*) are notably successful in overseas plantations and their seed is highly sought after. In contrast, species of subgenus *Eucalyptus* (the monocalypts) generally have not performed as well outside Australia, usually due to poorer survival rates.

The wood is used for a variety of purposes. It is generally denser and more highly coloured than that of subgenus *Eucalyptus*. The wood and particularly the lignotubers of many species make excellent firewood.

The name *Symphyomyrtus* is the original generic name (publ. 1844) of bushy yate (*Symphyomyrtus lehmannii* R. Br.), and alludes

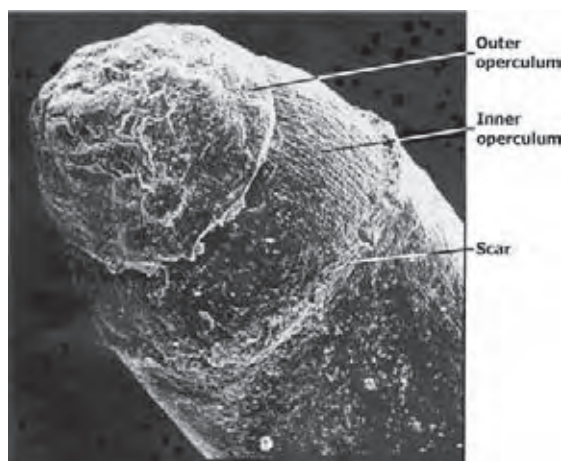


Figure 29. A bud of *E. behriana* in a very early stage of development showing the outer operculum being shed and the resulting scar which is retained through to flowering. (The bud is 1 mm diameter [×70].)

to the fused hypanthia seen readily in the inflorescences of the species. The distinction was later regarded as superficial and bushy yate was considered to belong to genus *Eucalyptus*.

Symphyomyrtus is botanically complex and consists of about 15 sections, some of which consist of a single species, e.g. *E. cladocalyx* of section *Sejunctae*, others comprising numerous series and subseries. All species of this subgenus have two bud opercula in contrast to the single operculum in species belonging to subgenus *Eucalyptus*. The outer operculum sheds early in the bud development for most of the species leaving an obvious scar, which is retained until flowering (Fig. 29), while a few retain both opercula up to the flowering stage. A large group, section *Bisectae*, is distinguished by having deeply bisected cotyledons (see Fig. 16c) while the remainder of the species has bilobed (Fig. 16b) or reniform (Fig. 16a) cotyledons. Of these, another large group, section *Adnataria*, has adnate anthers (see Fig. 25b, i, ii) compared with the versatile anthers of most of the other sections (Fig. 25a, i). A commercially important section, namely *Latoangulatae* (= *Transversaria* Pryor and Johnson 1971), is notable for having discolorous adult leaves with somewhat transverse venation. One of the three other large sections, namely *Dumaria*, is distinguished

generally by its mallee habit and the presence of glands in pith of the young branchlets. The species of section *Exsertaria* (the red gums, broadly speaking) have seedlings with petiolate leaves while species of section *Maidenaria* usually have seedlings with sessile leaves. As botanical group-

ings are by necessity defined by the association of many characters, the above are generalisations, and exceptions may be found in each group, e.g. species of section *Maidenaria*, series *Ovatae*, often have seedlings with shortly petiolate leaves.



Some species from the diverse and widespread subgenus *Symphyomyrtus* occur on islands to the north of Australia, including parts of the Australian plate in Indonesia, for example 1. *Eucalyptus urophylla*, Wetar Island, 2. *E. pellita*, near Muting, West Irian, and 3. *E. alba*, Alor Island.

Sugar Gum

Eucalyptus cladocalyx F. Muell.

Sugar gum attains around 8–15 m in height and up to 0.4 m dbh on its poorer sites, while in high rainfall areas in the Flinders Ranges it sometimes attains 35 m in height with a dbh of 1–1.5 m. On the latter sites it has clear straight stems to two-thirds of the tree height, while on the poorer sites stems may be only one-third to half the height and often crooked. Crowns generally have a fairly open appearance due to the foliage being concentrated in clumps at the ends of the branches.

Sugar gum is endemic to South Australia where it occurs in three disjunct areas. Trees of the best growth and form occur in the southern Flinders Ranges towards the top and east of Spencer Gulf. The other localities are Kangaroo Island and the Eyre Peninsula including the Cleve Hills west of Cowell.

Throughout its range this species grows on ridge tops and upper slopes, except on Kangaroo Island where it grows near creeks. The soils are mainly skeletal or frequently rather shallow or deep sands or ironstone gravels. Rock substrates include quartzite or occasionally limestone.

Sugar gum occurs in open forests in the higher rainfall areas of its range and in woodlands in the drier areas. Associated eucalypt species include South Australian blue gum (*E. leucoxylon*), inland grey box (*E. microcarpa*), long-leaved box (*E. goniocalyx*), peppermint box (*E. odorata*), soap mallee (*E. diversifolia*) and Kangaroo Island narrow-leaved mallee (*E. cneorifolia*).

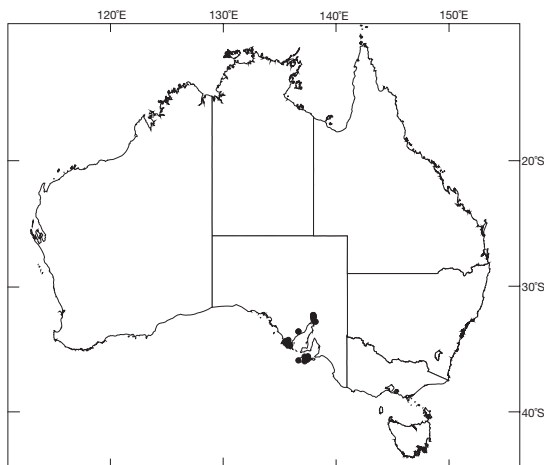
Related species: Brooker (2000) placed sugar gum in a monotypic section (*Sejunctae*) in subgenus *Symphyomyrtus*. It was previously placed in section *Bisectaria* (Pryor and Johnson 1971) but the cotyledons are not typical of this group. Widely cultivated in southern Australia, it is readily distinguished by the erect tree habit, the almost orbicular juvenile leaves, glossy discoloured adult leaves, and unusual inflorescences clustered on leafless sections of the branchlets inside the current leaf crop. The form on Eyre Peninsula is often referred to as *var. nana* (a name that has horticultural origins—see Blakely 1934), and is a much smaller tree with a spreading crown.

Publication: *Linnaea* 15, 388 (1852). Type: Marble Range (near Coffin Bay), South Australia, Feb. 1852, C. Wilhelmi.

Names: Botanical—Greek *clados* (branch, shoot), *calyx* (calyx), not really appropriate and in fact was intended to be the later published *corynocalyx*. Common—refers to the sweet taste of the juvenile foliage which contains glucoside.

Bark: Smooth throughout, often colourful due to shedding of old bark in irregular plates, resulting in patches of off-white, yellowish, grey and bluish grey, somewhat like karri (*E. diversicolor*) and grey gums (e.g. *E. punctata*).

Leaves: Seedling—opposite for about 3 pairs then alternate, petiolate, quickly changing from broad-lanceolate to ovate then orbicular, 3.4–5 × 3–6 cm, dark green, strongly discoloured. Juvenile—alternate, petiolate, more or less orbicular, 5.5–6 × 7.5–9 cm, dark green, strongly discoloured. Intermediate—alternate, petiolate, broad-lanceolate,



14–17 × 3–4.5 cm, dark green, glossy, strongly discoloured. Adult—alternate, petiolate, lanceolate, 11–15 × 2–2.5 cm, dark green, glossy, strongly discoloured.

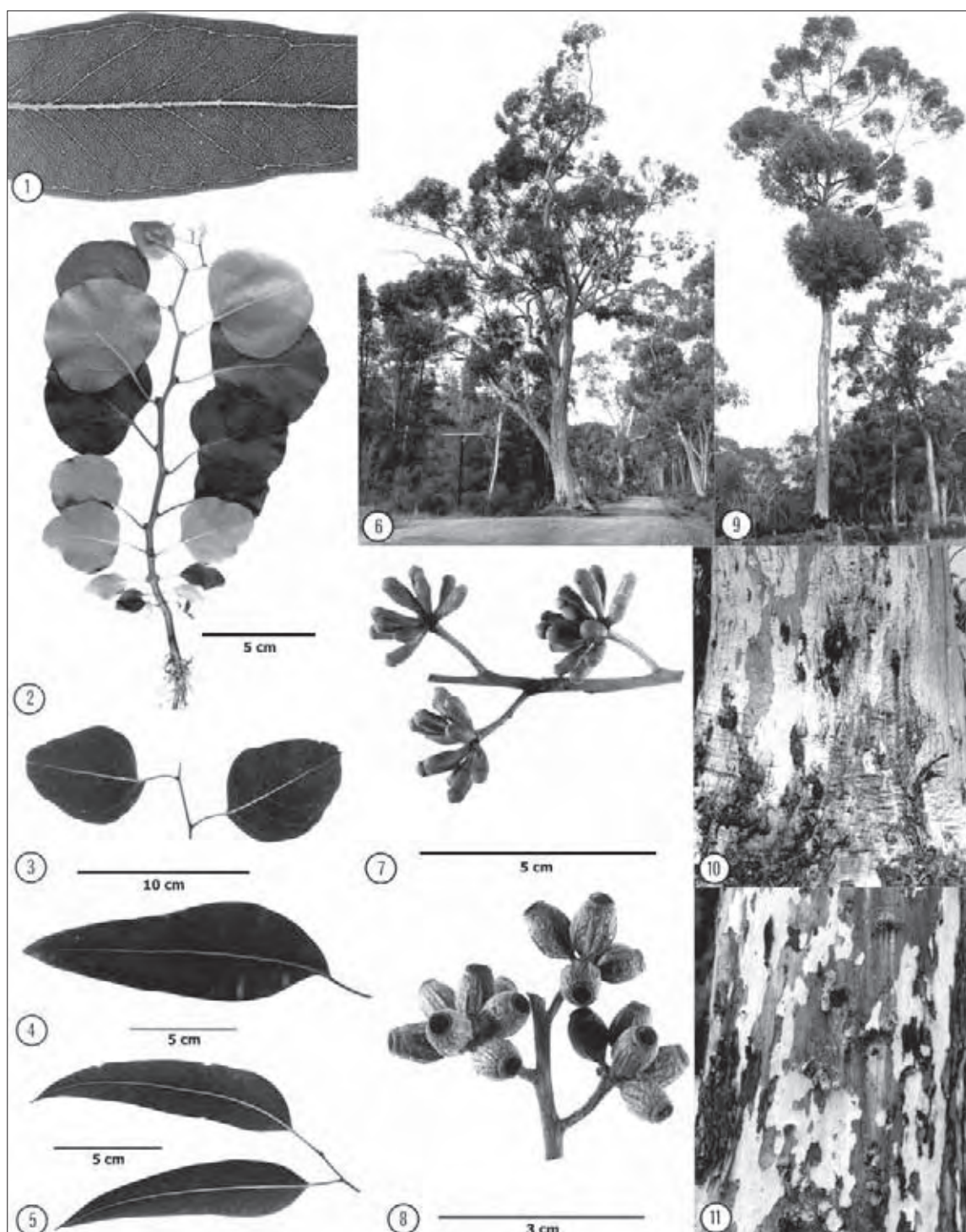
Inflorescences: Simple, axillary, occurring on leafless sections of branchlets inside the current leaf crop, 7 to 11-flowered; peduncles stout, terete, 1–1.7 cm long; pedicels 0.2–0.7 cm long; buds cylindrical to urceolate, 0.8–1.1 × 0.35–0.5 cm, with faintly ribbed hypanthia; opercula flattened-hemispherical, slightly wider than top of hypanthia and with small pointed tips. Flowers Jan.–Apr.

Fruits: Pedicellate, ovoid or urceolate, usually ribbed, 0.9–1.6 × 0.6–1 cm; disc moderately broad, descending; valves 3 or 4, deeply enclosed. Seeds flattened-ovoid, slightly flanged, light grey-brown, hilum ventral.

Wood: Sapwood pale and *Lyctus* susceptible, heartwood pale yellow-brown sometimes with greenish cast, with fine, uniform texture, grain commonly interlocked, hard, heavy, of moderate strength and is one of the most durable eucalypts that is also termite resistant; density about 665–1400 kg m⁻³; used for poles, posts, general construction and railway sleepers. Sugar gum is planted extensively across southern Australia, as an ornamental, windbreak and shelterbelt species, and for timber production.

Climate: Altitudinal range: near sea level to 600 m; Hottest/coldest months: 23–32°C/4–9°C; Frost incidence: low to moderate (15–20 each year at northern sites); Rainfall: 380–650 mm per year, winter max.

Distinctive features: A smooth-barked tree with bark shed in irregular plates leaving colourful patches; orbicular juvenile leaves; leaves strongly discoloured; fruits ovoid, with deeply enclosed valves.



Eucalyptus cladocalyx 1. Adult leaf venation 2. Seedling 3. Juvenile leaves 4. Intermediate leaf 5. Adult leaves 6, 9. Trees, Wirrabara Forest Reserve, southern Flinders Ranges, S.A. 7. Buds 8. Fruits 10, 11. Bark

Hillgrove Gum Brittle Gum

Eucalyptus michaeliana Blakely

Hillgrove gum is a small to medium-sized, erect woodland or forest tree. It may attain 30 m in height and 1–1.5 m dbh. The crown is fairly dense, beginning at about half tree height, although the tree may branch from near ground level when growing on poor sites.

This species is known principally from three disjunct areas, in New South Wales, between Cessnock and Wiseman's Ferry, not far north of Sydney and in the Hillgrove–Enmore districts on the Northern Tableland of New South Wales. In south-eastern Queensland it occurs on the high country near Mt Ballon and on the Macpherson Range along the border with New South Wales.

Hillgrove gum occurs on broad, flat-topped ridges, which are spurs from high tablelands, on mountain slopes and on lower valley slopes below massive sandstone outcrops. The soils vary from clays derived from shales to sandy alluvials.

This species occurs as scattered trees in somewhat wet open forests or as small almost pure stands. Some occurrences are adjacent to closed rainforests. On the moister sites there may be round-leaved gum (*E. deanei*), Dunn's white gum (*E. dunnii*), and Sydney blue gum (*E. saligna*). On drier and poorer sites it may occur with thin-leaved stringybark (*E. eugenioides*) and silver-topped stringybark (*E. laevopinea*).

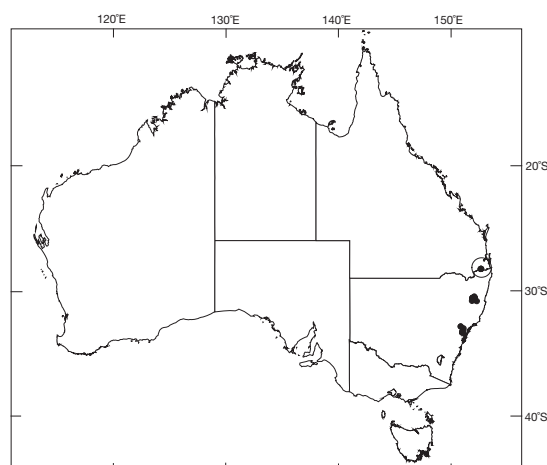
Related species: Hillgrove gum belongs in a monospecific section (*Racemus*), as it is not closely related to other species (Brooker 2000). The bark and leaves, however, are not distinctive when compared to other species. Its uniqueness in the subgenus is the inflorescence, which is compound in the axils. Apparent compound inflorescences (due to the early loss of the terminal vegetative shoot) only occur in subgenus *Symphomyrtus* in the large 'box' and 'ironbark' groups (section *Adnataria*). In the field, Hillgrove gum may resemble a red gum (section *Exsertaria*) or a grey gum (section *Latoangulatae*) species, but because of its unusual inflorescence is unlikely to be confused with any other species. A study by Steane *et al.* (2002) using DNA markers placed Hillgrove gum closest to species in sect. *Maidenaria*.

Publication: *Proc. Linn. Soc. N. S. W.* 63, 67 (1938). Type: Hillgrove and Enmore, New South Wales, Mar. 1907, J.F. Campbell.

Names: Botanical—after the Rev. Canon N. Michael (1884–1951), Anglican clergyman, Queensland, who took a lifelong interest in the flora of the State. Common—after the site where it was first collected.

Bark: Mostly smooth, shedding in small plates or flakes, giving a mottled or blotched appearance variously of white, yellow, grey, green or red.

Leaves: Seedling—opposite for up to 7 pairs then subopposite, lanceolate, 5–8 × 1.2–2 cm, strongly discolorous, green above, grey-green below. Juvenile—alternate or subopposite, shortly petiolate, lanceolate then broad-lanceolate, 5–15 × 1.2–5.5 cm, dull, green, concolorous. Intermediate—alternate or subopposite, petiolate, broad-lanceolate, 10–15 × 2.5–4 cm, firm texture, green, slightly discolorous. Adult—alternate to



occasionally subopposite, petiolate, lanceolate to slightly falcate, 15–20 × 2–3 cm, dull, green, concolorous to slightly discolorous.

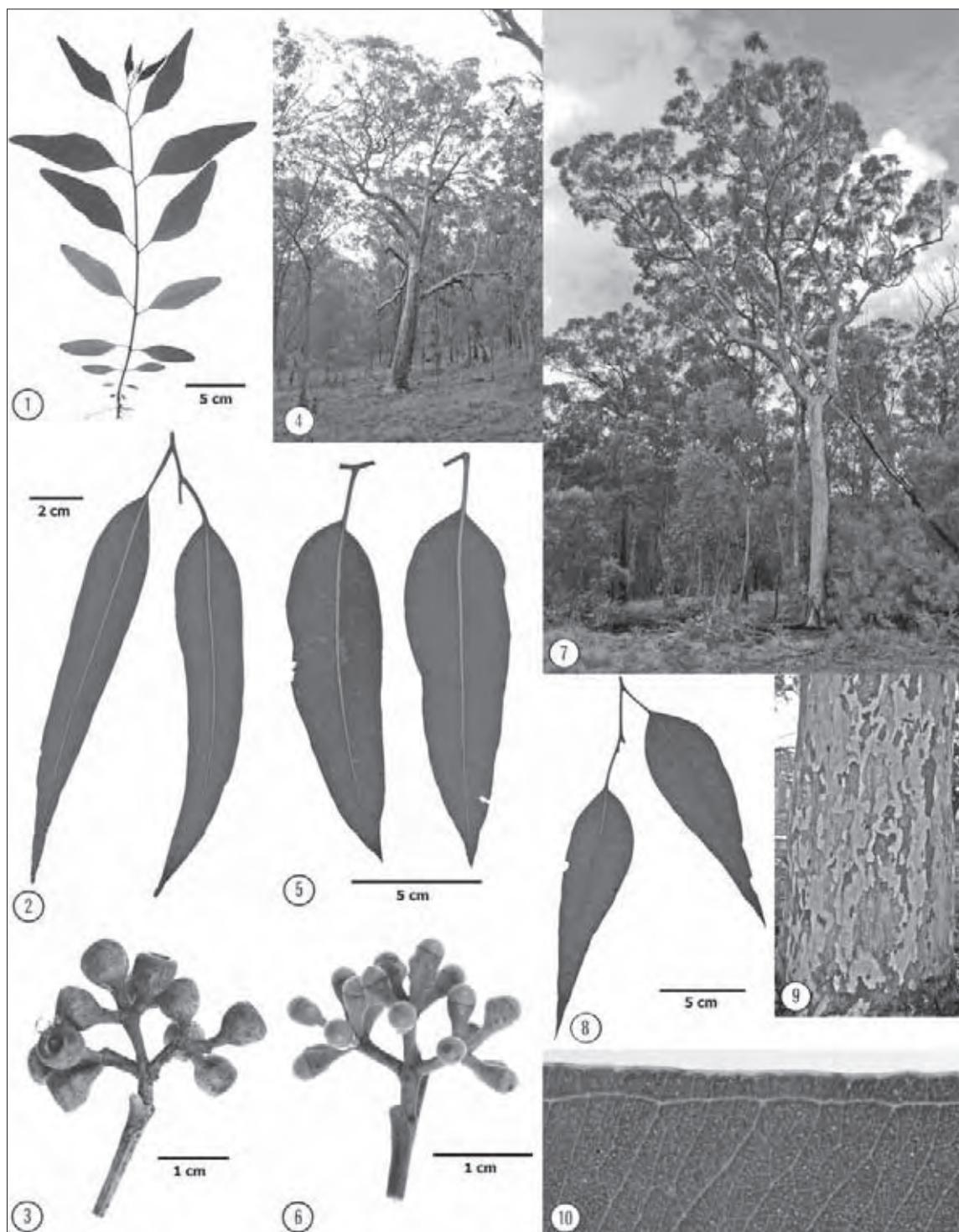
Inflorescences: Compound, axillary, consisting of a short axis (0.8–1.2 cm long) bearing 3(5) unit inflorescences that are 3 or 7-flowered; peduncles flattened, to 1 cm long; pedicels 0.2–0.5 cm long; buds ovoid to obovoid, 0.4–0.5 × 0.2–0.3; opercula subconical to hemispherical. Some trees have been reported as having flowers with purplish to scarlet filaments. Flowers spring.

Fruits: Shortly pedicellate, cupular or barrel-shaped, 0.4–0.5 × 0.4–0.5 cm; disc annular or level; valves 3 or 4, to rim level. Seeds cuboid, brown, hilum ventral.

Wood: Heartwood reported to be red, brittle; other properties not known.

Climate: Altitudinal range: 80–1020 m; Hottest/coldest months: 25–26°C/2–3°C; Frost incidence: low to moderate (particularly northern high elevation sites); Rainfall: 800–1200 mm per year, summer max.

Distinctive features: Erect tree with blotchy, often colourful bark; inflorescences axillary, compound; small fruit to 0.5 cm wide.



Eucalyptus michaeliana 1. Seedling 2. Adult leaves 3. Fruits 4, 7. Trees, near Hillgrove, N.S.W. 5. Juvenile leaves 6. Buds 8. Intermediate leaves 9. Bark 10. Adult leaf venation

Tuart

Eucalyptus gomphocephala DC.

Tuart is usually a tall tree attaining 25–40 m in height and 1–2 m dbh, but in the northern part of its distribution it may be reduced to about 10–15 m in height. The trunk is often short and a third to under a half the total tree height; the crown is well developed and fairly dense, with large, spreading branches.

Tuart is restricted to a narrow belt of coastal south-western Western Australia, from near Cervantes, some 200 km north of Perth, southwards to near Busselton. The distribution is frequently only 1 km wide, to the lee of coastal sand dunes. The inland extensions of distribution tend to follow rivers. The tallest trees up to 40 m tall are at the southernmost extent of its range in Ludlow National Park near Busselton.

At Ludlow tuart grows on nearly flat country on shallow siliceous sands, which have developed from marine deposits. Just north of Bunbury it grows on hilly to undulating country developed from aeolian deposits. Soils have weak profile development with limestone at a depth of about 2 m, and are typically neutral to alkaline. It does not occur on highly calcareous dunes.

Tuart usually occurs in pure stands in woodlands or open forests. Stands near Busselton are unique for the species as they occur as tall open forests. A typical understorey species is Swan River peppermint (*Agonis flexuosa*), which regenerates vigorously after tuart logging. Other associated species include sheoak (*Allocasuarina fraseriana*) and several *Banksia* species. Tuart also occurs in mixed eucalypt forests with jarrah (*E. marginata*), marri (*E. calophylla*), yate (*E. cornuta*) and with moitch (*E. rudis*) near watercourses.

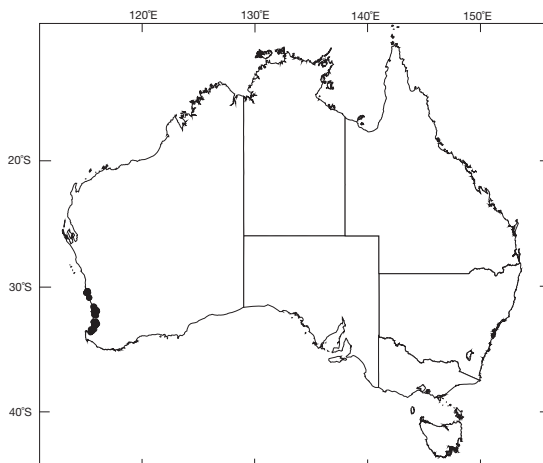
Related species: Tuart is considered taxonomically isolated and occupies the monotypic section *Bolites* (Brooker 2000). The cotyledons are somewhat bilobed, the bark box-type, the branchlets yellowish, the adult leaves glossy green, densely reticulate with minute oil glands, while the buds are the most recognisable character, being stout and mushroom-shaped. In its natural habitat it is unlikely to be confused with any other species.

Publication: DC. *Prodr.* 3, 220 (1828). Type: Geographe Bay, 'N. Holl. cote orient; Mus. Far. 1821', Western Australia, May 1821, J. Leschenault.

Names: Botanical—Greek *gomphos* (club-shaped), *cephale* (head), in reference to the operculum. Common—of Aboriginal origin.

Bark: Box-type bark, persistent throughout, subfibrous and finely fissured, light grey; older basal bark usually tessellated.

Leaves: Seedling—opposite for about 5 or 6 pairs then alternate, petiolate, ovate, often cordate, 6–9 × 4–7 cm, green, discolorous. Juvenile—alternate, petiolate, ovate, often cordate, 9–15 × 5.5–10 cm, green, discolorous. Intermediate—alternate, petiolate, broad-lanceolate, 12–20 × 3–5 cm, green, concolorous. Adult—alternate, petiolate, lanceolate, 9–16 × 1.6–2.5 cm, green, concolorous.



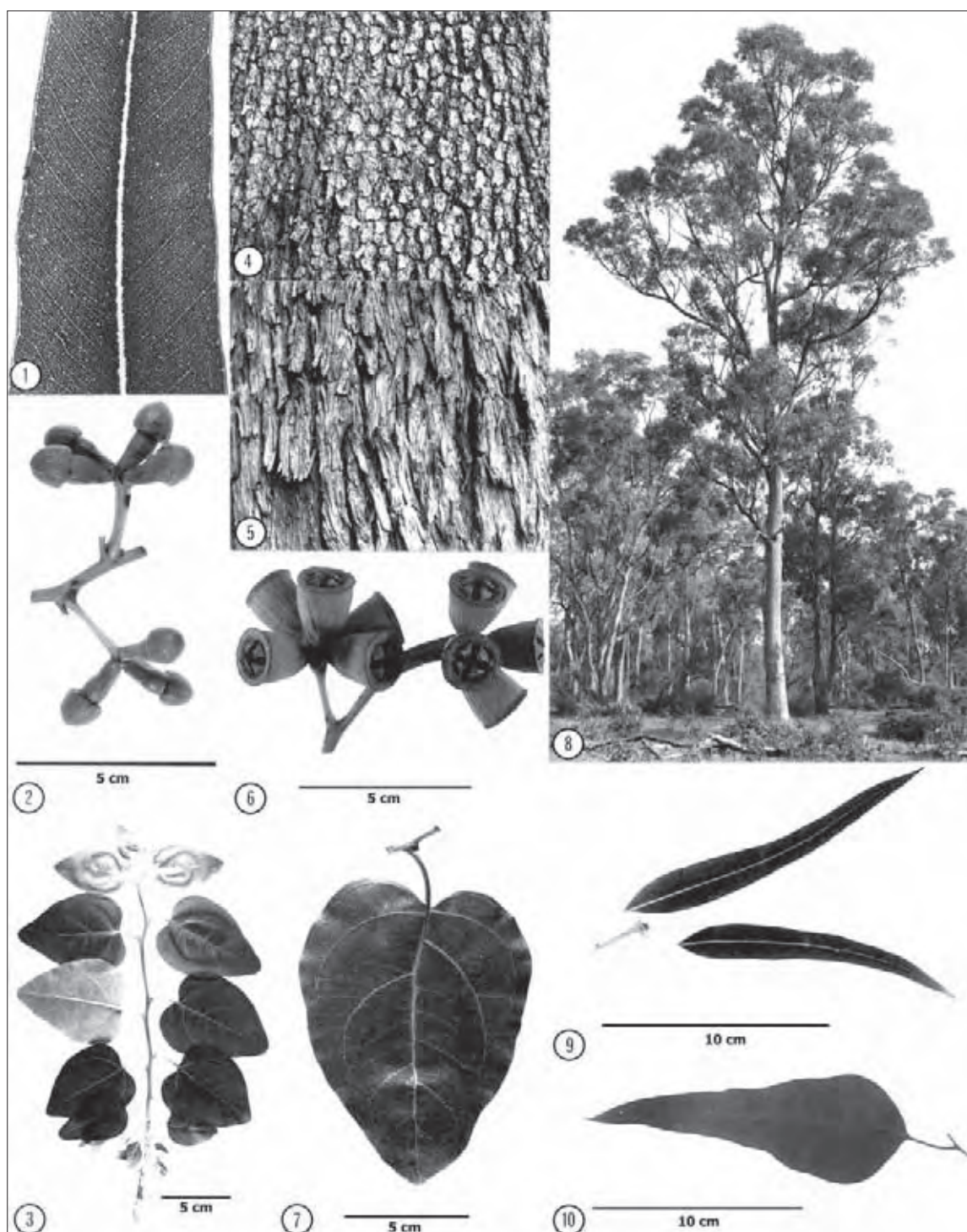
Inflorescences: Simple, axillary, 7-flowered; peduncles broad, flattened, 1.3–2.7 cm long; pedicels absent or up to 0.4 cm long; buds 1.4–2 × 0.8–1.5 cm, hypanthia obconical to campanulate, often with ribs continuing from pedicels; opercula hemispherical or sometimes shallowly conical, much broader than the base of the buds; highly susceptible to damage by the tuart bud weevil (*Haplonyx tibialis*). Flowers Jan.–Apr.

Fruits: Sessile or very shortly pedicellate, campanulate or occasionally cylindrical, often faintly ribbed, 1.3–2.2 × 1.3–1.7 cm; disc broad, convex, level or ascending slightly; valves broad-based, deltoid, more or less horizontal, at rim level or slightly exserted. Seeds saucer-shaped, often flanged, grey-black, hilum ventral.

Wood: Heartwood pale yellowish, fine-textured and with interlocked grain, very hard, strong, tough and very durable, relatively termite resistant; density about 890–1160 kg m⁻³; once used for keelsons, stern posts, bridge supports, shafts and wheelwright work where great strength, solidity and durability were required, and also railway carriage construction.

Climate: Altitudinal range: near sea level to 50 m; Hottest/coldest months: 26–30°C/8–10°C; Frost incidence: low; Rainfall: 800–900 mm per year, winter max.

Distinctive features: Moderately large, rough-barked, non-lignotuberous tree; branchlets yellow, adult leaves glossy green with widely spaced side veins; inflorescences 7-flowered on broad, strap-like peduncles; buds more or less sessile with hemispherical or shallowly conical operculum of larger diameter than the hypanthium; fruits campanulate to cylindrical, moderately large.



Eucalyptus gomphocephala 1. Adult leaf venation 2. Buds 3. Seedling 4, 5. Bark 6. Fruits 7. Juvenile leaf 8. Tree, near Bunbury, W.A. 9. Adult leaves 10. Intermediate leaf

Karri

Eucalyptus diversicolor F. Muell.

Karri is the tallest tree of Western Australia and is only exceeded in height by a few eucalypt species in Victoria and Tasmania. One tree felled in 1901 at Pemberton was 87 m. The more usual dimensions are 45–70 m tall with dbh commonly 1.5–3 m. The trunk is straight and up to two-thirds of the tree height.

Karri occupies a limited area of high rainfall country in the extreme south-west of Western Australia. The main occurrence extends from Nannup and the upper Donnelly River in the north, south-east to Denmark. It consists of about 300 000 ha in a long narrow belt mainly about 16–25 km wide and almost parallel to the coast between Albany and Cape Leeuwin, with several outliers. One outlier is on coastal limestone immediately inland of the massive coastal dune system between Karridale and Forest Grove, and other smaller ones usually around granite-gneiss bosses are at Mount Many Peaks, Torbay and Rocky Gully near Mt Barker; another is in the Porongorup Range.

Karri occurs on undulating to hilly country. In the lower rainfall zones it is confined to the valleys, but where the rainfall is higher it extends up hill slopes and on to ridges. Soils are acidic, with textures varying from fine sands to sandy loams derived from underlying granitic rocks. Such soils are very low in nutrients for agriculture and are deficient in such trace elements as zinc, copper and cobalt.

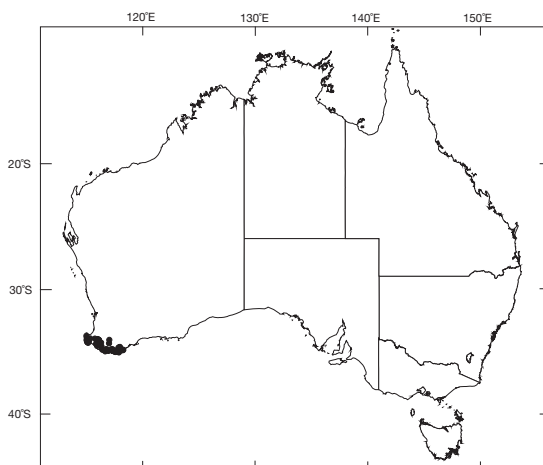
Karri occurs mainly in tall open forests and in the main commercial forest area of about 120 000 ha, it is mainly in pure stands while the balance is usually in mixture with marri (*E. calophylla*) and, to a considerably lesser extent, jarrah (*E. marginata*), red tingle (*E. jacksonii*), or yellow tingle (*E. guilfoylei*). Sheoak (*Allocasuarina decussata*) and karri wattle (*Acacia pentadenia*) are common understorey species.

Related species: Brooker (2000) placed karri as the only species in section *Inclusae*. It is readily distinguished among the very tall trees of Western Australia by its great height and smooth bark. The strongly discoloured adult leaves resemble those of species in the eastern section *Latoangulatae* (= *Transversaria* Pryor and Johnson 1971) and sugar gum, while the bark is similar to that of the grey gums (also section *Latoangulatae*). The buds and fruits are quite unlike those of these eastern species. Recent evidence from DNA markers indicate that karri is related to a large group of species from section *Bisectae* that are mainly endemic to the south-west of Western Australia (Steane *et al.* 2002).

Publication: *Fragm.* 3, 131 (1863). Type: ?Wilsons Inlet, Western Australia, A. Oldfield 788.

Names: Botanical—Latin *diversus* (diverse), *color* (colour), presumably alluding to the strongly discoloured leaves. Common—of Aboriginal origin.

Bark: Shed over the whole of the trunk in irregular plates, leaving a smooth surface, reddish grey, pale orange, whitish grey or yellowish white.



Leaves: Seedling—opposite for about 6–8 pairs then becoming alternate, distinctly petiolate, elliptical to ovate or almost orbicular, 4–8 × 2–6 cm, green, discoloured. Juvenile—alternate, petiolate, broadly ovate to almost orbicular, 8–11 × 6–10 cm, green, discoloured. Intermediate—alternate, petiolate, broad-lanceolate, 11–15 × 3.3–4.5 cm, green, discoloured. Adult—alternate, petiolate, broad-lanceolate, 9–12 × 2–3.2 cm, green, discoloured.

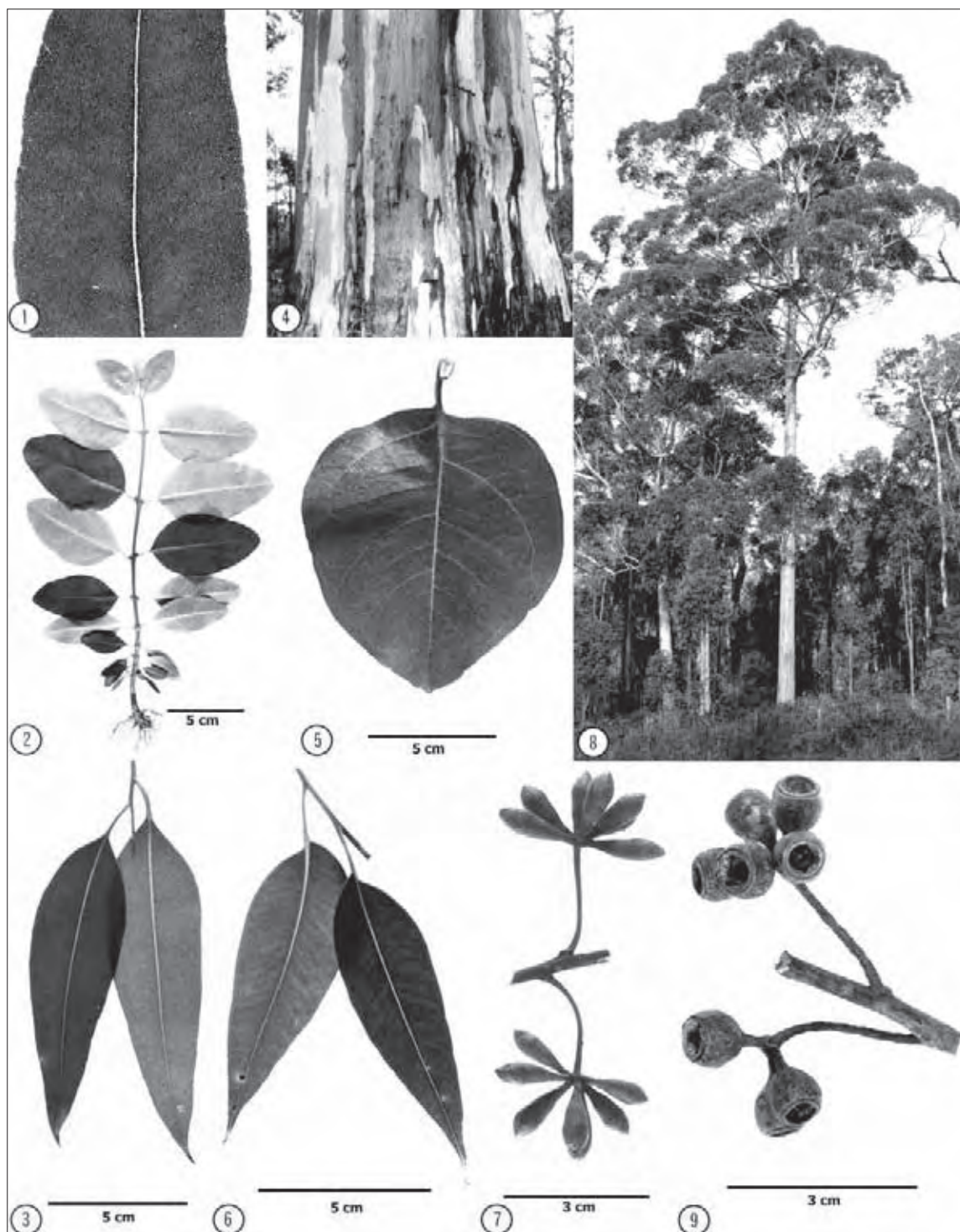
Inflorescences: Simple, axillary, 7-flowered; peduncles angular to flattened, 1.8–2.8 cm long; pedicels 0.3–0.6 cm long; buds clavate, 1–1.4 × 0.5–0.7 cm; opercula conical. Flowers Sept.–Feb.

Fruits: Pedicellate, ovoid, 0.8–1.2 × 0.7–1 cm; disc broad, steeply descending; valves 3, prominent, erect, tips to rim level or slightly below. Seeds ovoid to ellipsoid, dark grey, hilum ventral.

Wood: Sapwood not susceptible to *Lyctus*, heartwood reddish brown, not termite resistant, hard, heavy, strong, stiff and tough, moderately durable, grain often interlocked; density about 790–985 kg m⁻³; closely resembling jarrah but slightly lighter in colour, the second most important commercial timber in Western Australia and was, before World War II, exported in large quantities for use as building timbers, flooring and guides or sliding beams in mines. Larger lengths are available than from any other hardwood. Also used for plywood, which is especially favoured for concrete formwork and truck flooring. Cull karri logs were used in the pulp and paper industry.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 25–30°C/5–8°C; Frost incidence: low; Rainfall: 900–1300 mm per year, winter max.

Distinctive features: A very tall non-lignotuberous tree, with smooth bark to ground level; petiolate seedling leaves; strongly discoloured leaves at all stages; 7-flowered inflorescences; fruits ovoid, about 0.7–1 cm diameter.



Eucalyptus diversicolor 1. Adult leaf venation 2. Seedling 3. Intermediate leaves 4. Bark 5. Juvenile leaf 6. Adult leaves 7. Buds 8. Tree, near Manjimup, W.A. 9. Fruits

■ Eastern Blue Gums, Red Mahoganies and Grey Gums

Eucalyptus section *Latoangulatae* Brooker

This group, previously informally referred to as section *Transversaria* Pryor and Johnson (1971), consists of up to 20 species including several which are important timber trees in Australia. They include the eastern blue gum, red mahogany and grey gum groups.

The species are largely confined to a coastal strip and adjacent coastal ranges from Bairnsdale in eastern Victoria (*E. botryoides*), to Iron Range north of Coen in northern Queensland (*E. pellita*). Some of the most impressive and important species in the east coast forests are the eastern blue gums, examples of which such as flooded gum (*E. grandis*), Sydney blue gum (*E. saligna*) and round-leaved gum (*E. deanei*) are superb forest trees reaching heights of up to 75 m and possess long, clean, gum-barked trunks of great beauty.

One species in the section, the long known but not described till 1977, Timor mountain gum (*E. urophylla*) is endemic outside Australia and occurs naturally on several Indonesian islands. It has been planted for many years in Brazil and mistakenly called *E. alba*. *E. pellita* grows also in New Guinea.

While most of the species are trees of good form and often of great height, species such as *E. scias* (the southern form of *E. pellita*), which occurs from Cessnock south to the Batemans Bay region, can be reduced to a mallee on sandstone scarps of the Pigeon House Range. The timber of most species is of moderate to high durability, and extensive use is made of it for heavy construction, flooring, ship building and paper pulp.

Botany

The section is divided into three distinctive series, viz. *Transversae*, the eastern blue gums (e.g. *E. grandis*), *Annulares*, the red mahoganies (e.g. *E. resinifera*) and *Lepidotae-Fimbriatae*, the grey gums (e.g. *E. punctata*). Woollybutt and cup gum (*E. longifolia* and *E. cosmophylla*) were once included in the section but they are now recognised to be unrelated and differ, among several other characters, in the concolorous adult leaves, discolorous leaves being diagnostic for the *Latoangulatae*.

The grey gums are prominent colourful trees in season. The bark is smooth but somewhat coarse-grained. It decorticates in relatively large flat slabs or strips irregularly over several consecutive years. The freshly exposed parts are yellowish to bright orange, making the trees very conspicuous when mixed in natural forest stands with other species. Weathering bleaches the bark colour and the whole trunk is characteristically blotched with shades of orange, yellow, grey and white.

Two other subseries, *Transversae* and *Annulares*, are closely related and show a gradient in bark from the completely smooth-barked, round-leaved gum (*E. deanei*) through the partly rough-barked, Sydney blue gum (*E. saligna*), to the fully rough-barked red mahoganies (*E. pellita* and *E. resinifera*).

The inflorescences are simple and axillary. Opercula vary from horn-shaped as in red mahogany (*E. resinifera*) to hemispherical in some forms of *E. scias*. Anthers are oblong, versatile and open by longitudinal slits. Fruits vary greatly in size (e.g. *E. propinqua* and *E. robusta*) and valve characters are essential in distinguishing the two important commercial species, *E. grandis* and *E. saligna* (see below).



The gum-barked species in section *Latoangulatae* present some of the most scenically attractive forests in eastern Australia, while providing a renewable resource for timber production. 1–2. Mature and regenerating stands of flooded gum (*E. grandis*) in the Coffs Harbour district, N.S.W. 3. Sydney blue gum (*E. saligna*), Styx River State Forest, N.S.W. 4. Flooded gum (*E. grandis*), near Bulahdelah, N.S.W. (image: O. Strewé). 5. An intergrade stand of bangalay (*E. botryoides*) and Sydney blue gum (*E. saligna*) near Batemans Bay, N.S.W.

Round-leaved Gum Mountain Blue gum, Deane's Gum

Eucalyptus deanei Maiden

Round-leaved gum in good situations commonly attains heights of 45–65 m and diameters of 1–2 m with clear, straight boles up to two-thirds of the total height. Exceptional specimens exceed 75 m, making them among the tallest trees in New South Wales. On poorer sites it is reduced to 20–30 m with a short, thick trunk and large, heavily branched crown. Roundish to broad juvenile and intermediate leaves often occur in the mature crown giving a distinctive appearance.

Round-leaved gum has two disjunct occurrences in eastern Australia. The southern one extends from near Picton northwards to near Singleton, while the northern occurrence is from south-east of Armidale in New South Wales extending northwards into southern Queensland, possibly as far as the D'Aguilar Range west of Brisbane.

This species reaches its best development on the bottoms and lower slopes of sheltered, fertile and well-watered valleys, but also occurs on the upper slopes of ridges and over undulating topography both in coastal lowlands and on high tablelands. It occurs on a range of soil types including loams, clay loams and sandstone-derived soils.

Round-leaved gum occurs in open and tall open eucalypt forests, often associated with Sydney blue gum (*E. saligna*), grey gum (*E. punctata*), messmate (*E. obliqua*), manna gum (*E. viminalis*), river peppermint (*E. elata*), New England blackbutt (*E. andrewsii* subsp. *campanulata*), silvertop stringybark (*E. laevopinea*) and also turpentine (*Syncarpia glomulifera*).

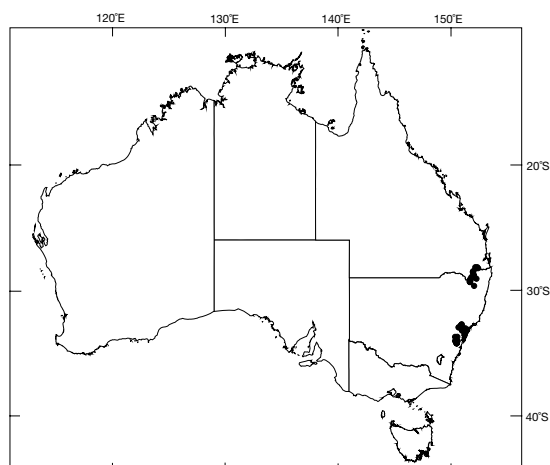
Related species: Round-leaved gum is one three species in the series *Transversae* (Brooker 2000). It differs from Sydney blue gum (*E. saligna*) and flooded gum (*E. grandis*) by the completely smooth bark and the broad adult leaves, which provide a distinctive crown. The fruits are clearly pedicellate, cupular to campanulate and smaller than those of the related species. The valves of the fruits are level to only slightly exerted. The roundish juvenile leaves are conspicuous in the field. The northern disjunct occurrence of round-leaved gum from Armidale in New South Wales northwards to the D'Aguilar Range west of Brisbane in southern Queensland was described as a distinct species *E. brunnea* by Johnson and Hill (1990) but its differences from *E. deanei* are slight.

Publication: *Proc. Linn. Soc. N.S.W.* 29, 471 (1904). Type: The Valley, near Springwood (Blue Mountains) west of Sydney, New South Wales, Apr. 1888, H. Deane.

Names: Botanical—honours H. Deane (1847–1924), one time Engineer-in-Chief of Construction, New South Wales Railways, and a keen amateur botanist. Common—refers to the more or less orbicular juvenile leaves.

Bark: Mostly smooth and white with bluish grey patches where plates or flakes of older bark have been shed; some trees retain a short stocking of rough, scaly, dead bark.

Leaves: Seedling—opposite for 5 or 6 pairs then alternate, distinctly petiolate from start, ovate to almost orbicular, 3.8–7.6 × 1.6–5.2 cm, green, discolorous. Juvenile—alternate,



petiolate, ovate to almost orbicular, 6–15 × 4.5–8.5 cm, green, discolorous. Intermediate—alternate, petiolate, often tapered to a point, ovate to broad-lanceolate, 10–18 × 3–4.5 cm, green, discolorous. Adult—alternate, petiolate, often tapered to a long fine point, broad-lanceolate to lanceolate, 8–12.5 × 1.7–3.5 cm, green, discolorous. Late juvenile and intermediate leaves predominate on many trees giving a very broad-leaved appearance to the crown.

Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles angular to flattened, 0.7–1.4 cm long; pedicels angular, to 0.5 cm long; buds clavate, 0.5–0.6 × 0.3–0.4 cm; opercula hemispherical-apiculate. Flowers Mar.–May.

Fruits: Pedicellate, cylindrical to campanulate, 0.4–0.6 × 0.4–0.6 cm; disc more or less level to descending; valves 3(4), about rim level or exerted, often curved outwards. Seeds ovoid to cuboid, brown or grey, hilum ventral to terminal.

Wood: Sapwood susceptible to attack by *Lyctus* borers; heartwood light red to reddish brown, coarse-textured, easy to work, finishes well, moderately durable, fairly difficult to season being prone to high shrinkage and severe checking, distortion and collapse; density about 960 kg m⁻³; potentially useful for flooring, panelling and general construction if it can be dried successfully.

Climate: Altitudinal range: 100–1200 m; Hottest/coldest months: 25–30°C/0–5°C; Frost incidence: moderate to high (up to 50 each year and snow falls at high elevation sites); Rainfall: 750–1500 mm per year, uniform to summer max.

Distinctive features: Under favourable conditions a large forest tree, almost entirely smooth-barked; juvenile and intermediate leaves broad and quite common on mature trees; leaves distinctly discolorous at all stages; opercula hemispherical-apiculate; buds and fruits pedicellate.



Eucalyptus deanei 1. Adult leaf venation 2. Adult leaves 3. Juvenile leaves 4. Seedling 5. Bark 6. Buds 7. Tree, Putty Road, south-west of Singleton, N.S.W. 8. Fruits

Flooded Gum Rose Gum (Qld)

Eucalyptus grandis W. Hill ex Maiden

Flooded gum is a tall to very tall forest tree generally 45–55 m in height and 1.2–2 m dbh. Exceptional specimens attain 75 m in height and exceed 3 m dbh. A tree near Bulahdelah in New South Wales is reported to be 87 m tall. Form is generally excellent with clear, straight boles often to two-thirds or three-quarters of the total height.

Flooded gum has one major area of occurrence from around Newcastle in New South Wales northwards to around Bundaberg in Queensland. Smaller stands occur to the west of Mackay in central Queensland, near Townsville in the ranges north-west and Mt Elliot to the south and near Daintree in northern Queensland.

This species occurs on flats or lower slopes of deep, fertile valleys, very commonly fringing rainforest. It prefers moist, well-drained, deep, loamy soils of alluvial or volcanic origin.

Flooded gum occurs in tall open forests, either in pure stands or associated with species such as pink bloodwood (*E. intermedia*), blackbutt (*E. pilularis*), tallwood (*E. microcorys*), red mahogany (*E. resinifera*) and Sydney blue gum (*E. saligna*). Other associates include turpentine (*Syncarpia glomulifera*), brush box (*Lophostemon confertus*) and forest oak (*Allocasuarina torulosa*). Occasionally occurs within closed rainforests.

Related species: Brooker (2000) placed flooded gum in the series *Transversae* with two other species. It differs from round-leaved gum (*E. deanei*) by the frequent black butt of rough bark, the crown wholly of lanceolate adult leaves, and the shorter pedicels. It differs from Sydney blue gum (*E. saligna*) most conspicuously by the valves of the fruits which are 4 or 5 in number, broadish, blunt, incurved and often pruinose, those of *E. saligna* are in 4s, thin, pointed, strongly erect or outward-curved and non-pruinose.

Publication: *J. Proc. Roy. Soc. N.S.W.* 52, 501 (1919). Type: New South Wales, W. Hill 74.

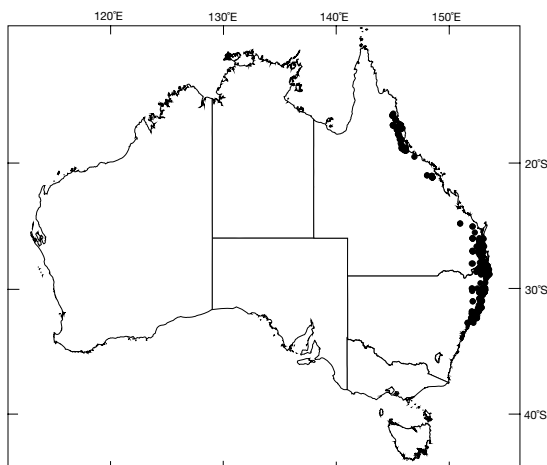
Names: Botanical—Latin *grandis* (large, big, tall), refers to the large size this species commonly attains. Common—refers to preferred habitat in very moist (but well-drained) areas.

Bark: Generally with a short 'stocking' of greyish, flaky rough bark for 1–4 m, smooth, powdery, white, greyish white or bluish grey above.

Leaves: Seedling—opposite for 4 or 5 pairs then alternate, petiolate, ovate, 4–9.5 × 2–4 cm, green to dark green, strongly discolorous. Juvenile—alternate, petiolate, ovate, 10–14 × 5.5–8.5 cm, green to dark green, strongly discolorous. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 16–18 × 3–5 cm, dark green, discolorous. Adult—alternate, petiolate, lanceolate, 10–16 × 2–3 cm, dark green, discolorous.

Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles flattened, 0.8–1.8 cm long; pedicels absent, or up to 0.3 cm long and angular, angles continuing as ribs along hypanthium; buds more or less pyriform to ovoid, 0.5–0.8 × 0.3–0.4 cm; opercula conical or somewhat rostrate. Flowers Apr.–Aug.

Fruits: Sessile or very shortly pedicellate, broadly obconical, slightly contracted at rim, 0.5–0.8 × 0.4–0.7 cm; disc narrow,



more or less level; valves 4 or 5, relatively broad, exserted and incurved, usually pruinose; branchlets and fruits sometimes pruinose. Seeds ovoid, brown or yellow, hilum ventral.

Wood: Sapwood pale pink, generally resistant to attack by *Lyctus* borers; heartwood pink to light red, with a rather coarse texture very similar to Sydney blue gum (*E. saligna*) and bangalay (*E. botryoides*), kino (gum) veins common, straight-grained, moderately strong, moderately durable; density rather variable, air-dry density 545–955 kg m⁻³; used for general construction, joinery, plywood, panelling, boat building and flooring. Major plantations established overseas for pulp and paper production.

Climate: Altitudinal range: near sea level to 600m, but up to 1100 m in the tropical north; Hottest/coldest months: 24–30°C/3–8°C; Frost incidence: low (but occasional at high elevations); Rainfall: 1000–3500 mm per year, summer max.

Distinctive features: A tall non-lignotuberous tree of excellent form, bark smooth, white apart from a short black rough butt; leaves discolorous at all stages; fruits with 4 or 5 relatively broad, slightly exserted, incurved valves, often pruinose.



Eucalyptus grandis 1. Adult leaves 2. Seedling 3. Fruits 4. Intermediate leaf 5. Buds 6. Adult leaf venation 7. Juvenile leaves 8. Stand, near Bulahdelah, N.S.W. 9, 10. Bark

Sydney Blue Gum Blue Gum

Eucalyptus saligna Smith

Sydney blue gum is a tall to very tall tree 30–55 m in height with dbh up to 2 m. Exceptional specimens may attain 65 m in height and 2.5 m dbh. The trunk is generally of excellent form, straight and clear of branches for half to two-thirds of the total tree height.

Sydney blue gum is fairly common from the South Coast area of New South Wales to around Maryborough in southern Queensland, mostly within 120 km of the coast. Farther north there are a few isolated, disjunct occurrences in the Eungella area west of Mackay, the Kroombit Tops south-west of Gladstone, the Blackdown Tableland near Blackwater and the Consuelo Tableland and Carnarvon Gorge area north-west of Injune. These outlier populations share a number of features with the closely related *E. grandis*.

Best development of this species is on good quality alluvial sandy loams. Other soils include sandy clays with strongly differentiated profiles and volcanic loams. Soils are generally moist but well drained.

Sydney blue gum occurs in open or tall open eucalypt forests often associated with blackbutt (*E. pilularis*), tallowwood (*E. microcorys*), spotted gum (*E. maculata*), flooded gum (*E. grandis*), grey gums (*E. punctata*, *E. propinqua*), thin-leaved stringybark (*E. eugenoides*), brush box (*Lophostemon confertus*), turpentine (*Syncarpia glomulifera*), forest oak (*Allocasuarina torulosa*) and rough-barked apple (*Angophora floribunda*).

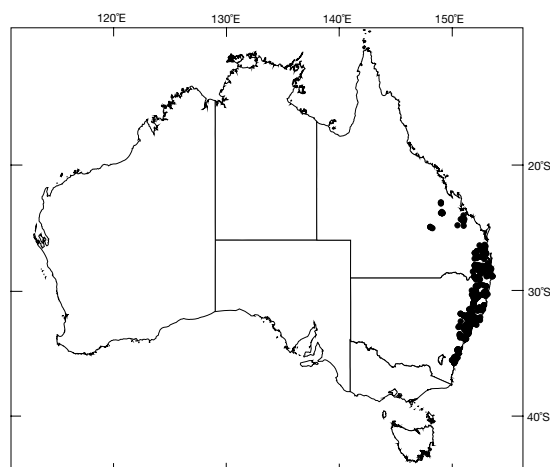
Related species: Brooker (2000) placed Sydney blue gum in series *Transversae* with two other species. Round-leaved gum (*E. deanei*) differs by having more or less orbicular juvenile leaves and almost completely smooth bark. Flooded gum (*E. grandis*) and Sydney blue gum are sometimes almost identical except for the valves—broadish, blunt, incurved, often pruinose and in 4s or 5s for flooded gum; thin, pointed, strongly erect or outward-curved, non-pruinose and in 4s for Sydney blue gum. Bark colour differs to some extent between the two—normally completely white or pale grey in flooded gum; often with long bluish grey mottles over white or pale grey in *E. saligna*. Intergrade populations of Sydney blue gum and the related bangalay (*E. botryoides*) (series *Annulares*) occur where their distributions overlap (e.g. near Batemans Bay, Kangaroo Valley and Woy Woy areas in New South Wales). Intergrade trees have very long stockings of basal bark. Passioura and Ash (1993) recognised bangalay as a subspecies of *E. saligna*, a concept not widely accepted.

Publication: *Trans. Linn. Soc. London* 3, 285 (1797). Type: Port Jackson, New South Wales, 1794, J. White.

Names: Botanical—Latin *salignus* (willowy, willow-like), allusion rather obscure. Common refers to the occurrence in the Sydney area and to the sometimes bluish appearance of the smooth bark.

Bark: Rough and persistent, brownish or greyish, somewhat flaky bark retained at base for about 1–4 m, decortivating in long strips to leave smooth, bluish grey to white surface above.

Leaves: Seedling—opposite for 4 or 5 pairs then alternate, petiolate, more or less elliptical, ovate to broad-lanceolate, 3.5–8.5 × 1–4 cm, green, strongly discolorous. Juvenile—



alternate, petiolate, ovate to broad-lanceolate, 8–14 × 3–5 cm, green, strongly discolorous. Adult—alternate, petiolate, lanceolate, 9–17 × 2–3 cm, green, discolorous. Seedling and juvenile branchlets are pruinose.

Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles flattened, 0.4–1.8 cm long; pedicels often absent but also up to 0.3 cm long, angular, the angles often continuing as ribs on the hypanthium; buds more or less ovoid, 0.6–0.9 × 0.3–0.4 cm; opercula conical. Flowers Jan.–Apr.

Fruits: Sessile or very shortly pedicellate, campanulate, cylindrical or pyriform, 0.5–0.8 × 0.4–0.7 cm; disc narrow, descending; valves 3 or 4, usually with thin, pointed tips, erect, protruding just above rim level or strongly exserted, erect or outcurved. Seeds brown, cuboid or ovoid, hilum ventral.

Wood: Heartwood very similar in appearance to flooded gum (*E. grandis*) and bangalay (*E. botryoides*). Sapwood pale pink, susceptible to attack by *Lyctus* borers; heartwood pink to red, usually straight-grained, moderately coarse-textured, kino (gum) veins common, relatively easy to work, fix, dress and finish, moderately durable; density 620–1000 kg m⁻³; used for general construction, flooring, cladding and panelling.

Climate: Altitudinal range: near sea level to 1100 m; Hottest/coldest months: 22–33°C/–2–8°C; Frost incidence: low to high (up to more than 60 at higher elevations); Rainfall: 900–1800 mm per year, summer max.

Distinctive features: A tall lignotuberous forest tree of good form, predominantly smooth-barked; leaves discolorous at all stages; fruits with erect, exserted, thin, pointed valves, which are usually erect or outcurved.



Eucalyptus saligna 1. Buds 2. Adult leaves 3. Seedling 4. Fruits 5. Intermediate leaves 6. Juvenile leaves 7. Adult leaf venation 8. Stand, north of Batemans Bay, N.S.W. 9, 10. Bark

Bangalay Southern Mahogany

Eucalyptus botryoides Smith

Bangalay can be a tall forest tree attaining 30–40 m in height and 1 m dbh with a straight trunk of good form. On poor sites, however, it is shorter though still of good form, and on open coastal locations exposed to saline winds, it may be reduced to a low, heavily branched tree, 8–12 m tall, with a dense crown and poorly defined main stem.

Bangalay grows in a narrow coastal belt from slightly north of Newcastle in New South Wales south to near Bairnsdale in coastal eastern Victoria. Some of the finest specimens can be seen in Kangaroo Valley about 120 km south of Sydney and around Club Terrace and Orbost in eastern Gippsland. In southern coastal areas poorly formed trees occur either immediately behind or on stabilised sand dunes.

Bangalay grows abundantly on poor sandy soils of coastal locations. Best growth and form occur farther inland, but still at relatively low altitudes, on moderately fertile loams of river valleys. Substrates include sandstone, shale and coastal dune systems.

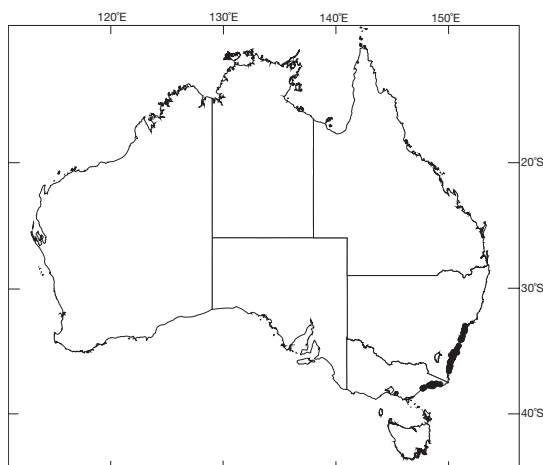
In open forests, bangalay may form a large part of mixed stands with species such as Sydney blue gum (*E. saligna*), turpentine (*Syncarpia glomulifera*) and sometimes spotted gum (*E. maculata*) and blackbutt (*E. pilularis*). In wetter forests there may be an understorey of temperate rainforest shrubs and small trees, which may include lilly pilly (*Acmena smithii*) and species of *Acacia*. On other sites there may be red bloodwood (*E. gummifera*) and, in the northern part of the range, red mahogany (*E. resinifera*). On the poor sites of stabilised sand dunes or immediately behind them, southern mahogany may form dense thickets with *Banksia* and as well there may be poorly formed stringybark (*E. globoides*) and silvertop ash (*E. sieberi*).

Related species: Bangalay is one of about eight species of red mahogany placed in series *Annulares* (Blakely) Chippendale (Brooker 2000). They are characterised by the thick, brown to reddish brown fibrous bark held in long vertical clumps.

Bangalay is related to swamp mahogany (*E. robusta*), a tree of coastal swampy sites in southern Queensland and northern New South Wales. It differs by the much larger, more pedicellate fruits in which the valves remain joined across the orifice. Bangalay is also related to the red mahogany (*E. resinifera*) of coastal New South Wales extending to northern Queensland, which differs by the pedicellate, more delicate buds and fruits and by the long acuminate opercula. Bangalay forms intergrade stands with Sydney blue gum (*E. saligna*) where the two come into contact. The latter is a mostly smooth-barked species with a stocking of rough bark. Intergrade stands typically have rough bark over most of the trunk but not to the branches as in bangalay, e.g. Kangaroo Valley and near Batemans Bay.

Publication: *Trans. Linn. Soc. London* 3, 286 (1797). Type: Port Jackson, New South Wales, 1793, J. White.

Names: Botanical—Greek *botrys* (cluster), probably refers to the clusters of the buds and fruits. Common—of Aboriginal origin.



Bark: Persistent to the medium-sized branches, thick, short fibred, coarsely fissured longitudinally and held in vertical clumps, becoming flaky-fibrous, brown to reddish brown, with smaller branches smooth, green, light brown or salmon-pink; forest form—thick, persistent bark usually less extensive, of finer texture, and grey rather than brown.

Leaves: Seedling—opposite for 5 or 6 pairs then alternate, petiolate, broad-lanceolate to ovate, 4.5–11 × 1.3–5.5 cm, green, discolorous. Juvenile—alternate, petiolate, ovate, 9–15 × 4–8.5 cm, green, discolorous. Adult—alternate, petiolate, often tapered to a long, fine point, broad-lanceolate, 10–16 × 2.5–4 cm, green, strongly discolorous.

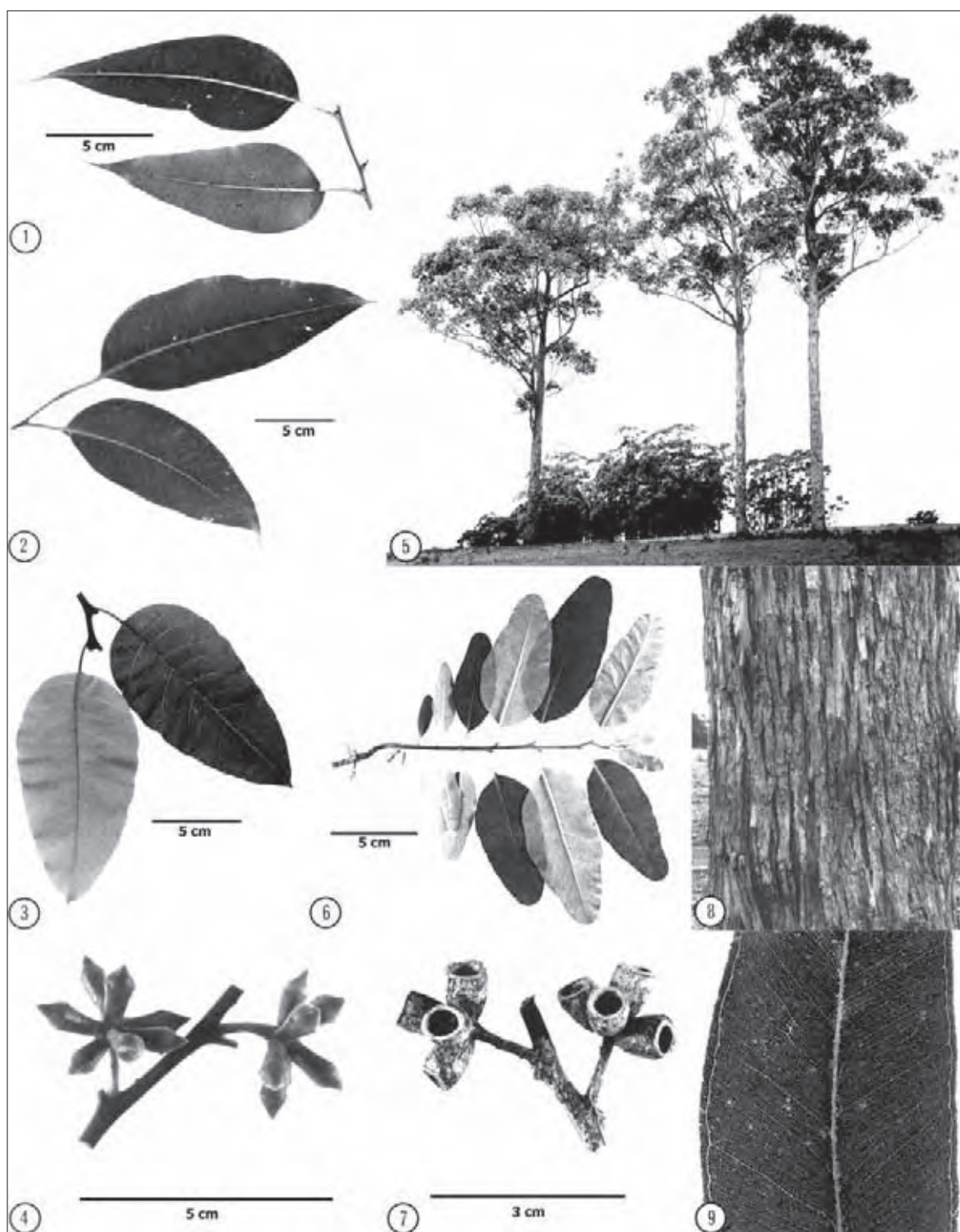
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles broad, flattened, 0.7–1.5 cm long; pedicels usually absent but occasionally up to 0.3 cm long, particularly for the centre bud; buds cylindrical or clavate, c. 0.9 × 0.6 cm, often with ribbed hypanthia; opercula vary from hemispherical to conical. Flowers Dec.–Feb.

Fruits: Sessile or very shortly pedicellate, cylindrical, 0.7–1.2 × 0.5–0.9 cm; disc moderately broad, descending; valves (3)4, below rim level. Seeds pyramidal, brown, hilum terminal.

Wood: Sapwood seldom attacked by *Lyctus* borers; heartwood deep pink to red, of medium texture, somewhat interlocked grain, slow-drying, durable; density 765–985 kg m⁻³; used for general structural purposes and useful for flooring and panelling. Heartwood very similar to flooded gum (*E. grandis*) and Sydney blue gum (*E. saligna*).

Climate: Altitudinal range: near sea level to 300m; Hottest/coldest months: 24–27°C/2–8°C; Frost incidence: low to moderate (5–20 each year at inland sites); Rainfall: 700–1300 mm per year, uniform to summer max.

Distinctive features: Persistent, thick rough bark; adult leaves firm, often conspicuously broad, discolorous, dark green above, pale below, with fine, regular venation; 7 to 11-flowered, with flattened peduncles and more or less sessile buds and fruits.



Eucalyptus botryoides 1. Adult leaves 2. Intermediate leaves 3. Juvenile leaves 4. Buds 5. Stand, near Orbost, Vic. 6. Seedling 7. Fruits 8. Bark 9. Adult leaf venation

Swamp Mahogany Swamp Messmate (Qld)

Eucalyptus robusta Smith

Swamp mahogany is a tree usually attaining heights of 20–30 m and dbh up to 1 m. The trunk is typically straight and about half the height of the tree. The crown has long, spreading, irregular branches, which carry a relatively dense canopy of broad leaves.

Swamp mahogany occurs in a very narrow coastal belt from north of Rockhampton in Queensland including Great Keppel Island, Fraser Island, Moreton Island and North and South Stradbroke Islands, to Jervis Bay in New South Wales.

This species has a restricted topographical range, mainly occurring in swamps and on the edges of saltwater estuaries and lagoons, or rarely on the lower slopes of valleys. The greater part of the occurrence is within a few kilometres of the sea, and only in a few locations of northern New South Wales and south-eastern Queensland does it penetrate farther inland. The soils are typically heavy clays, but the species grows well on light sandy clays; on Stradbroke, Moreton and Fraser Islands, off the Queensland coast, it is found on almost pure sands.

Swamp mahogany occurs in open forests, often in pure stands. When there are associated trees these may include red mahogany (*E. resinifera*), bloodwoods (*E. gummifera*, *E. intermedia*) and sometimes forest red gum (*E. tereticornis*). Other genera are represented by paperbarks (*Melaleuca* spp.) and swamp sheoak (*Casuarina glauca*).

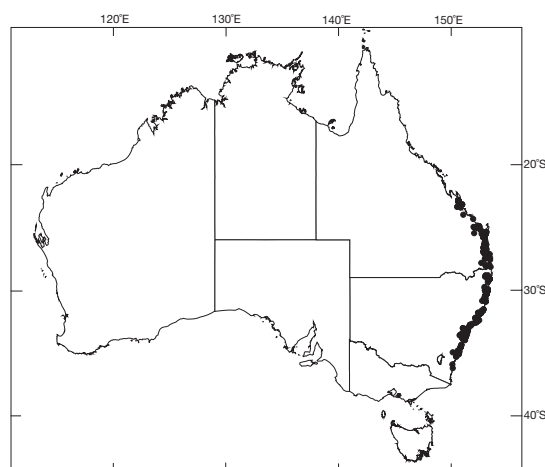
Related species: Swamp mahogany is one of about eight species of red mahogany placed in series *Annulares* (Brooker 2000). They are characterised by the thick, brown to reddish brown fibrous bark held in large vertical clumps. It is related to bangalay (*E. botryoides*), a tree of coastal and subcoastal regions of New South Wales south into eastern Victoria, which differs by the smaller, sessile to shortly pedicellate fruits in which the valves are not exserted. It is also related to the red mahogany (*E. resinifera*) of coastal New South Wales extending to northern Queensland which differs by the pedicellate, more delicate buds and fruits and by the long acuminate opercula, and is not restricted to swampy sites.

Publication: *Zoology and Botany of New Holland* 1, 39 (1793). Type: Port Jackson, New South Wales, 1793, J. White.

Names: Botanical—Latin *robustus* (robust), allusion obscure. Common—refers to the species preference for swampy sites and ‘mahogany’ refers to the similarity of the timber to that of a central American species *Swietenia mahogani* (see under *E. umbra*).

Bark: Rough and persistent to the small branches, thick, soft, spongy, subfibrous, tending to be in longitudinal clumps, red-brown.

Leaves: Seedling—opposite for about 6 or 7 pairs then alternate, petiolate, ovate, 6–11 × 2.5–5 cm, green, discolorous. Juvenile—alternate, petiolate, ovate, 12–19 × 4.5–8 cm, green, discolorous. Intermediate—alternate, petiolate, tapered to a long, fine point, ovate to broad-lanceolate, 15–26 × 5–9 cm, green, discolorous. Adult—



alternate, petiolate, tapered to a long, fine point, broad-lanceolate, 10–16 × 2.7–4.5 cm, green, strongly discolorous.

Inflorescences: Simple, axillary, 9 to 15-flowered; peduncles broad, flattened, 1.3–3 cm long; pedicels angular, 0.1–0.9 cm long, or rarely absent; buds 1.6–2.4 × 0.6–0.8 cm, with faintly ribbed, obconical hypanthia and rostrate opercula. Flowers May–Jul.

Fruits: Usually pedicellate, cylindrical or constricted in the middle, 1–1.8 × 0.6–1.1 cm; disc broad, descending; valves 3 or 4, slightly below rim level to slightly exserted, tips usually coherent across orifice. Seeds pyramidal, brown, hilum terminal.

Wood: Sapwood susceptible to attack by *Lyctus* borers; heartwood reddish brown, coarse-textured, straight-grained to highly interlocked, very durable, resistant to marine borers; density 625–955 kg m⁻³; used mostly as round timber for fencing and wharf construction.

Climate: Altitudinal range: near sea level to 90m; Hottest/coldest months: 24–32°C/6–13°C; Frost incidence: low; Rainfall: 1000–1700 mm per year, uniform to summer max.

Distinctive features: Bark subfibrous, soft, spongy, in longitudinal clumps, persistent to the small branches; leaves large, leathery, strongly discolorous, dark green on the upper surface; inflorescences 9 to 15-flowered; peduncles flattened; operculum rostrate, often broader than hypanthium, twice as long as wide; valve tips usually coherent after dehiscence.



Eucalyptus robusta 1. Buds 2. Fruits 3. Seedling 4, 8. Trees, between Coffs Harbour and Sawtell, N.S.W.
5. Adult leaves 6. Juvenile leaf 7. Intermediate leaves 9. Bark 10. Adult leaf venation

Large-fruited Red Mahogany Red Mahogany

Eucalyptus pellita F. Muell and *E. scias* L.A.S. Johnson & K.D. Hill

These are medium-sized trees commonly up to 30 m tall and 1 m dbh. They usually have a straight trunk to about half the tree height and a large heavily branched crown. On poor sites they are often only 15–20 m tall or in exposed coastal sites reduced to a low bushy tree 5–10 m tall.

E. pellita extends from Iron Range on Cape York Peninsula, south to Coen and from north of Cooktown to south of Ingham, with a small occurrence in between in Cape Melville National Park; it also extends into the southern lowlands of New Guinea. *E. scias* occurs in New South Wales and comprises two subspecies: the typical which extends from Batemans Bay north to Cessnock, and subsp. *apoda*, which is restricted to the Tenterfield region on the Northern Tablelands.

These species occur on gentle to moderate topography with some extension to steep, well-drained slopes. Best stands are on the lower slopes of large ridges or alongside streams. Soils vary from shallow sands and sandy clays to deep loams and deep coastal sands. Substrates include sandstone, granite and shale.

Large-fruited red mahoganies grow mainly in open eucalypt forests. Associates of *E. pellita* include cadaga (*E. toreliana*), carbeen (*E. tessellaris*), forest red gum (*E. tereticornis*), *Lophostemon* spp., acacias (*Acacia mangium*, *A. celsa*) and it sometimes grows in proximity to rainforests. Associates of *E. scias* include bloodwoods (*E. intermedia*, *E. gummifera*, *E. maculata*), blackbutt (*E. pilularis*) and stringybarks (*E. globoidea*).

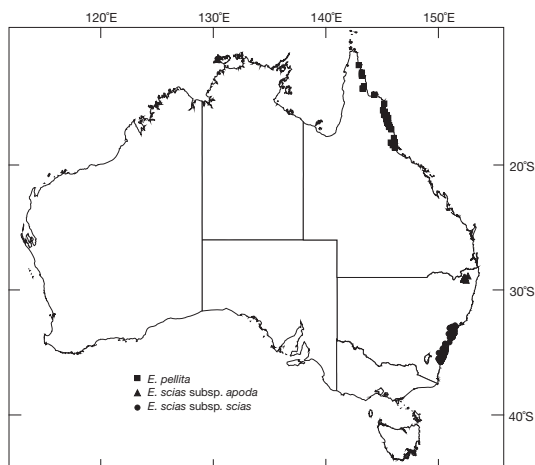
Related species: These two species are in the red mahogany group, series *Annulares* (Brooker 2000). Red mahogany (*E. resinifera*), from near Coen in Cape York Peninsula south to New South Wales, differs in the smaller buds and fruits and the long narrow opercula. Mountain mahogany (*E. notabilis*) of far south-eastern Queensland and New South Wales is a species of higher altitudes and is a smaller tree with smaller buds and fruits. Hill and Johnson (2000) recognise the northernmost populations of *E. pellita* from Cape York and New Guinea as *E. biterranea* and Johnson and Hill (1990) described *E. scias* subsp. *callimastha* from north of Wollongong south to Batemans Bay. These are difficult to distinguish from the typical forms.

Publication: *E. pellita*: *Fragm.* 4, 159 (1864). Type: Rockingham Bay, Queensland, 1864, J. Dallachy. *E. scias* subsp. *scias*: *Telopea* 4, 42 (1990). Type: West Head, Ku-ring-gai Chase National Park, 5 May 1971, M.I.H. Brooker 3039. *E. scias* subsp. *apoda*: *Telopea* 4, 44 (1990). Type: 26 km from Bruxner Hwy on Poverty Point road, E of Tenterfield, 10 Sep. 1985, K.D. Hill 1283, L.A.S. Johnson & J.B. Williams.

Names: Botanical—Latin *pellitus* (covered with a skin), allusion obscure; Greek *skias* (shade) refers to the broad-leaved crown; Greek *apoda* (without a foot) has sessile flower buds. Common—fruits are larger than *E. resinifera* or *E. notabilis*.

Bark: Rough and persistent to the small branches, shortly fibrous, longitudinally fissured, reddish-brown to brown.

Leaves: Seedling—opposite for about 4–7 pairs then alternate, petiolate, ovate, 5–15 × 1.6–7 cm (*pellita*), 7.5–15 × 2.5–5.5 cm



(*scias*) green, discolorous. Juvenile—alternate, petiolate, ovate, 14–21 × 7–8.5 cm (*pellita*), 6–16 × 2–10 cm (*scias*), green, discolorous. Stems of seedling and juvenile stages conspicuously quadrangular in cross-section, with flanged edges. Adult—alternate, petiolate, usually tapered to a long, fine point, broad-lanceolate to lanceolate to falcate, 10–16 × 2–4 cm (*pellita*), 7–15 cm long, 2–3 cm (*scias*), green (*pellita*, *scias*) or bluish (*apoda*), strongly discolorous.

Inflorescences: Simple, axillary, usually 7-flowered or sometimes 3-flowered (*scias*); peduncles broad, flattened, 1–2.5 cm long; pedicellate, pedicels usually stout, angular, 0.1–0.9 cm long (*pellita*, *scias*) or pedicels absent (*apoda*); buds with obconical hypanthia, usually with ribs continuing from the angular pedicels, 0.9–2.3 × 0.6–1.4 cm; opercula highly variable, beaked, conical or hemispherical, either wider or narrower than hypanthia. Flowers Dec.–Feb.

Fruits: Sessile (*apoda*) or shortly pedicellate (*pellita*, *scias*), hemispherical to obconical, often slightly ribbed, 0.7–1.4 × 0.7–1.7 cm (*pellita*, *apoda*), to 1.6 × 2 cm (*scias*); disc broad, more or less level; valves usually 4, exserted; operculum scar prominent (usually broader than disc), concave. Seeds pyramidal, brown, hilum terminal.

Wood: Sapwood pale red, susceptible to attack by *Lyctus* borers; heartwood dark red (resembles *E. marginata*), grain somewhat interlocked, moderately coarse-textured, easy to work, finishes well, durable; density about 775–1085 kg m⁻³; used for flooring, cladding, panelling, sills and general construction purposes. The wood is identical to *E. resinifera*.

Climate: Altitudinal range: near sea level to 600 m (*pellita*), near sea level to 500 m (*scias*), 800–900 m (*apoda*); Hottest/coldest months: 31–38°C/10–19°C (*pellita*), 24–31°C/4–8°C (*scias*), 25–26°C/–1–2°C (*apoda*); Frost incidence: low (*pellita*), low to moderate at higher elevation sites (*scias*), high (*apoda*); Rainfall: 1200–3300 mm per year, summer max. (*pellita*), 900–1200 mm per year, ± uniform (*scias*), 800–900 mm per year, summer max. (*apoda*).

Distinctive features: Trees with thick, fibrous bark; discolorous leaves; inflorescences with strap-like peduncles; fruits with exserted valves; rim thick, prominent.



Eucalyptus pellita (p), *E. scias* (s) 1. Bark 2. Adult leaf venation 3. Adult leaves 4, 6, 9. Buds (s) 5. Intermediate leaves 7. Tree (p), between Mt Molloy and Mossman, Qld 8. Juvenile leaf 10. Tree (s), north of Batemans Bay, N.S.W. 11. Seedling 12. Fruits

Red Mahogany Red Messmate

Eucalyptus resinifera Smith

Red mahogany is a medium-sized to tall tree attaining 45 m in height and 1–1.5 m diameter, often with a clear, straight stem for half to two-thirds of the total tree height. There are two subspecies, the typical and subsp. *hemilampra*.

Typical red mahogany is endemic to New South Wales and occurs from Jervis Bay north to about Kempsey, while subsp. *hemilampra* occurs from Taree in New South Wales north to about Gladstone in south-eastern Queensland. Optimum development is in the Gympie district in southern Queensland.

Red mahogany is usually found on lowland slopes, in valleys and in sheltered flats. It grows on a wide range of soils, with best development on light, fertile sandy clay loams and on deep red loams of volcanic origin.

This species grows in open or tall open forests. Some of the more commonly associated eucalypts include blackbutt (*E. pilularis*), tallowwood (*E. microcorys*), white mahogany (*E. acmenoides*), flooded gum (*E. grandis*), grey gum (*E. punctata*), Gympie messmate (*E. cloeziana*) and pink bloodwood (*E. intermedia*); other associated genera may be *Lophostemon*, *Syncarpia* and *Allocasuarina*.

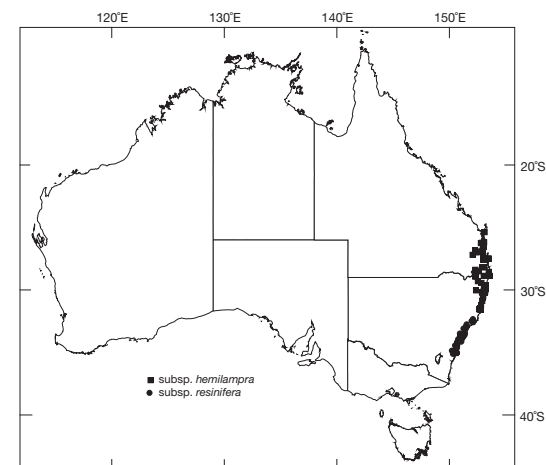
Related species: Red mahogany is one of about eight species in the red mahogany group, series *Annulares* (Brooker 2000). They are characterised by the thick, brown to reddish brown fibrous bark held in long vertical clumps. It is related to *E. pellita* of far northern Queensland, which has larger buds and fruits and shorter opercula. Swamp mahogany (*E. robusta*) of southern coastal Queensland and New South Wales differs in the preferred habitat, the beaked opercula and the coherent valves of the fruits. Red mahogany of far northern Queensland from the Windsor Tableland west of Daintree to near Townsville, with an outlier on the Eungella Range west of Mackay has been published as a different species, *E. macta* by Hill and Johnson (2000). This species is a tree to 35 m tall and differs from *E. resinifera* by the broader, shorter, more rostrate opercula and the larger broader and shorter fruits with a descending disc.

Publication: Subsp. *resinifera*: White's Journal of a Voyage to New South Wales, p. 231 (1790). Type: Port Jackson, New South Wales, J. White. Subsp. *hemilampra* (F. Muell.) L. Johnson & K. Hill: *Telopea* 4, 46 (1990). Type: Upper Brisbane River, Queensland, F. von Mueller.

Names: Botanical—Latin *resina* (resin), *fera* (bearing, carrying); this name is believed to have been applied due to an error involving a species of *Angophora* and is not appropriate for red mahogany; Greek *hemi-* (half) *lampra* (shining), possibly referring to the shiny upper side of the adult leaves compared to the paler undersides. Common—refers to the similarity of this species to that of a central American species *Swietenia mahoganii* (see under *E. umbra*).

Bark: Rough and persistent to the small branches, fibrous, soft, fissured longitudinally, held in thick vertical clumps, greyish to reddish brown.

Leaves: Seedling—opposite for 5 or 6 pairs then alternate, petiolate, ovate to broad-lanceolate, 5–13 × 1.2–5 cm, green, discolorous. Juvenile—alternate, petiolate, ovate to broad-



lanceolate, 13–23 × 3.5–7 cm, green, discolorous.

Intermediate—alternate, petiolate, usually tapering to a long, fine point, ovate to broad-lanceolate, 12–19 × 3–5 cm, green, discolorous. Adult—alternate, petiolate, usually tapering to a long, fine point, ovate to broad-lanceolate, 10–17 × 1.8–3.5 cm, green, discolorous.

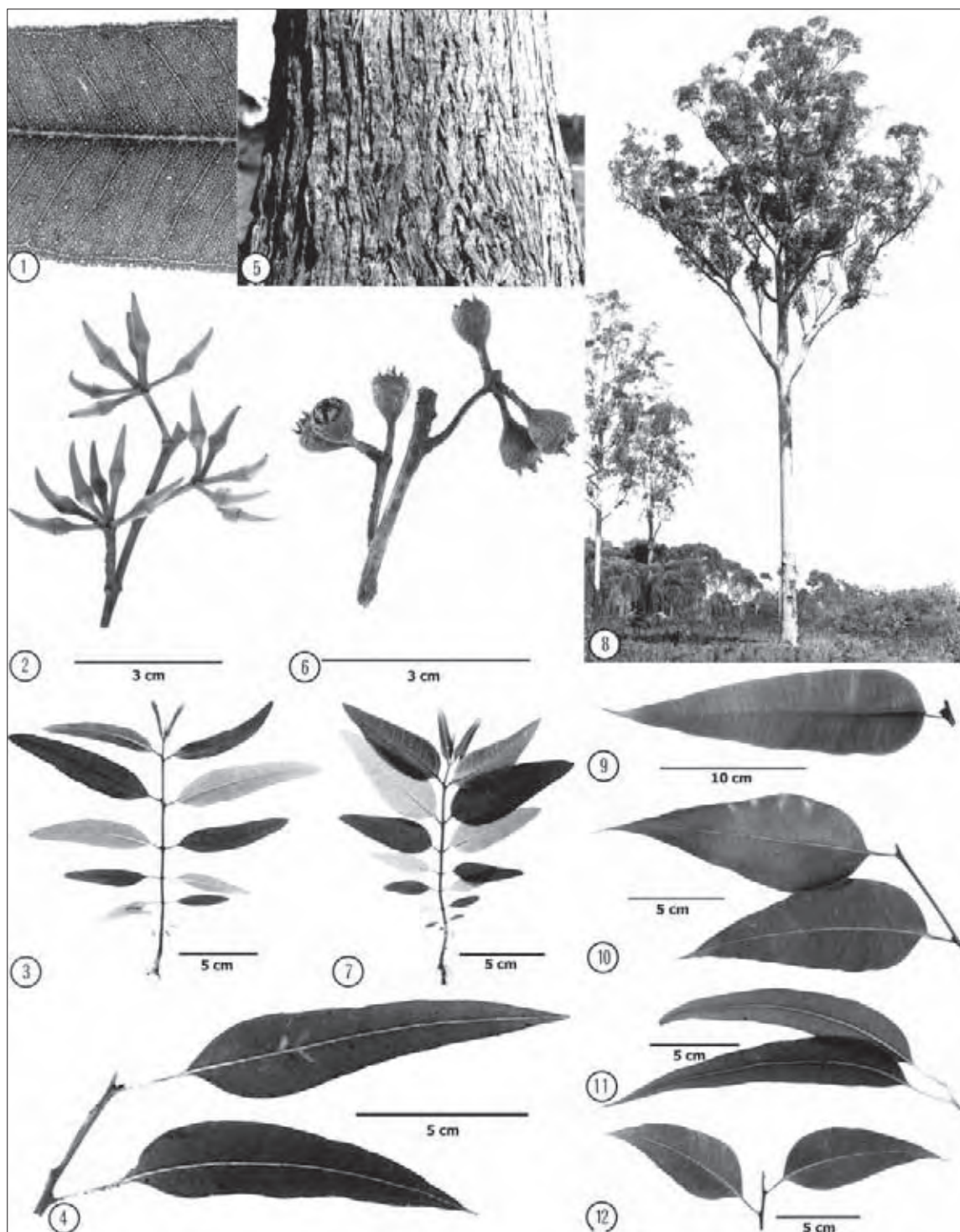
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles flattened, < 1.5 cm long (*resinifera*), > 1.5 cm long (*hemilampra*); pedicels angular, 0.3–1 cm long; buds 0.9–1.3 cm long (*resinifera*), 1.2–1.6 cm long, (*hemilampra*), hypanthia ribbed, more or less hemispherical; opercula elongated or horn-shaped, < 0.9 cm long (*resinifera*), > 0.9 cm long (*hemilampra*). Flowers Oct.–Feb.

Fruits: Pedicellate, ovoid to hemispherical, 0.5–0.6 × 0.5–0.7 cm (*resinifera*), 0.6–0.9 × 0.6–0.8 cm (*hemilampra*); disc variable, ascending, more or less level or descending; valves 3 or 4, strongly exserted. Seeds pyramidal, brown, hilum terminal.

Wood: Sapwood pale red, susceptible to attack by *Lyctus* borers; heartwood dark red, moderately coarse-textured, grain somewhat interlocked, easy to work, finishes well, durable; density 775–1085 kg m⁻³; used for flooring, cladding, panelling, sills, bridge decking and general construction purposes. Wood is identical to large-fruited mahogany (*E. pellita*).

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 24–34°C/1–13°C; Frost incidence: low to moderate; Rainfall: 900–1700 mm per year, summer max. to uniform in the south of its range.

Distinctive features: Bark fibrous, persistent to small branches, held in thick vertical clumps; leaves at all stages discolorous; buds with long conical or horn-shaped opercula; pedicellate fruits with strongly exserted valves.



Eucalyptus resinifera 1. Adult leaf venation 2. Buds 3, 7. Seedlings 4, 12. Adult leaves 5. Bark 6. Fruits 8. Tree (subsp. *hemilampra*), Glenugie State Forest, near Grafton, N.S.W. 9. Juvenile leaf 10, 11. Intermediate leaves

Grey Gum Small-fruited Grey Gum

Eucalyptus propinqua Deane & Maiden and *E. major* (Maiden) Blakely

The small-fruited grey gums are medium-sized to tall trees up to 40 m in height and dbh to 1 m. The form is typically good, with a straight trunk, which may be half to two-thirds of the tree height, while the crown is open and moderately small.

These are trees mainly of coastal and subcoastal eastern Australia. They occur from about Wyong just north of the Hawkesbury River in New South Wales to north of Gympie and west to the Blackbutt Range in south-eastern Queensland, with a small occurrence in higher country near Long Point south-east of Armidale on the northern tablelands of New South Wales (*propinqua*), or sporadically distributed in south-eastern Queensland from west of Brisbane to north of Maryborough, with outliers north of Monto and west to the Carnarvon Range (*major*).

These species are usually found on lowlands and low hills and ridges of undulating to hilly country mostly within 100 km of the sea, preferring slopes to valley floors. Grey gums grow on more elevated plateaux in inland Queensland and south-east of Armidale in New South Wales. Grey gums are found mainly on clays and clay loams derived from shale or sandy or gravelly loams derived from acid igneous rocks.

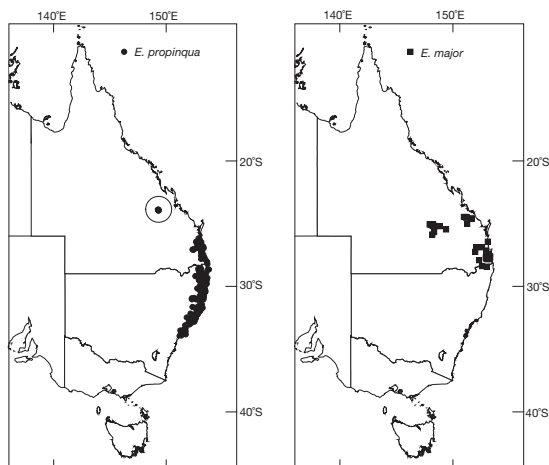
Their best development is in open or tall open eucalypt forests. *E. propinqua* commonly forms an interzone between species such as flooded gum (*E. grandis*) in the valleys and blackbutt (*E. pilularis*) on the upper slopes. Other associated eucalypts may include white mahogany (*E. acmenoides*), various stringybarks, Sydney blue gum (*E. saligna*) and tallowwood (*E. microcorys*). *E. major* is associated with numerous other tree species, including forest red gum (*E. tereticornis*), ironbarks (*E. fibrosa*, *E. crebra*), lemon-scented gum (*E. citriodora*) and smooth-barked apple (*Angophora costata*).

Related species: The grey gums belong in series *Lepidotaefimbriatae*, characterised by the smooth, granular, colourful bark (Brooker 2000). There are two groups: the small-fruited grey gums which are also characterised by the bark shedding in strips and the brown seeds, and the larger-fruited grey gums (e.g. *E. punctata*) whose bark sheds in large plates and has black-toothed seeds. The adult leaves are strongly discolorous in all grey gums, which distinguishes them from the somewhat related red gums (section *Exsertaria*), which have similar but less granular bark.

Publication: *E. propinqua*: Proc. Linn. Soc. N.S.W. 20, 541 (1895). Type: Dungog–Stroud road, New South Wales, 10 Feb. 1893, A. Rudder; *E. major*: Key Eucalypts, 100 (1934). Type: Norman Creek near Brisbane, Queensland, May 1917, C.T. White.

Names: Botanical—*propinqua*, Latin *propinquus* (near, related, allied), refers to the bark which is similar to that of *E. punctata*; *major*, Latin *major* (greater), referring to the larger buds and fruits by comparison with var. *propinqua*. Common—refers to the colour of the bark after weathering.

Bark: Shed from the trunk and larger branches in strips exposing orange bark which weathers to cream or light grey then dark grey or grey-brown, surface granular.



Leaves: Seedling—opposite for about 4–6 pairs then alternate, petiolate, ovate to broad-lanceolate, 5–8.5 × 1.5–2.5 cm, green, discolorous. Juvenile—alternate, petiolate, ovate to broad-lanceolate, 8–14 × 2.3–5 cm, green, discolorous. Adult—alternate, petiolate, lanceolate, 8–14 × 1.2–2.7 cm, green, discolorous.

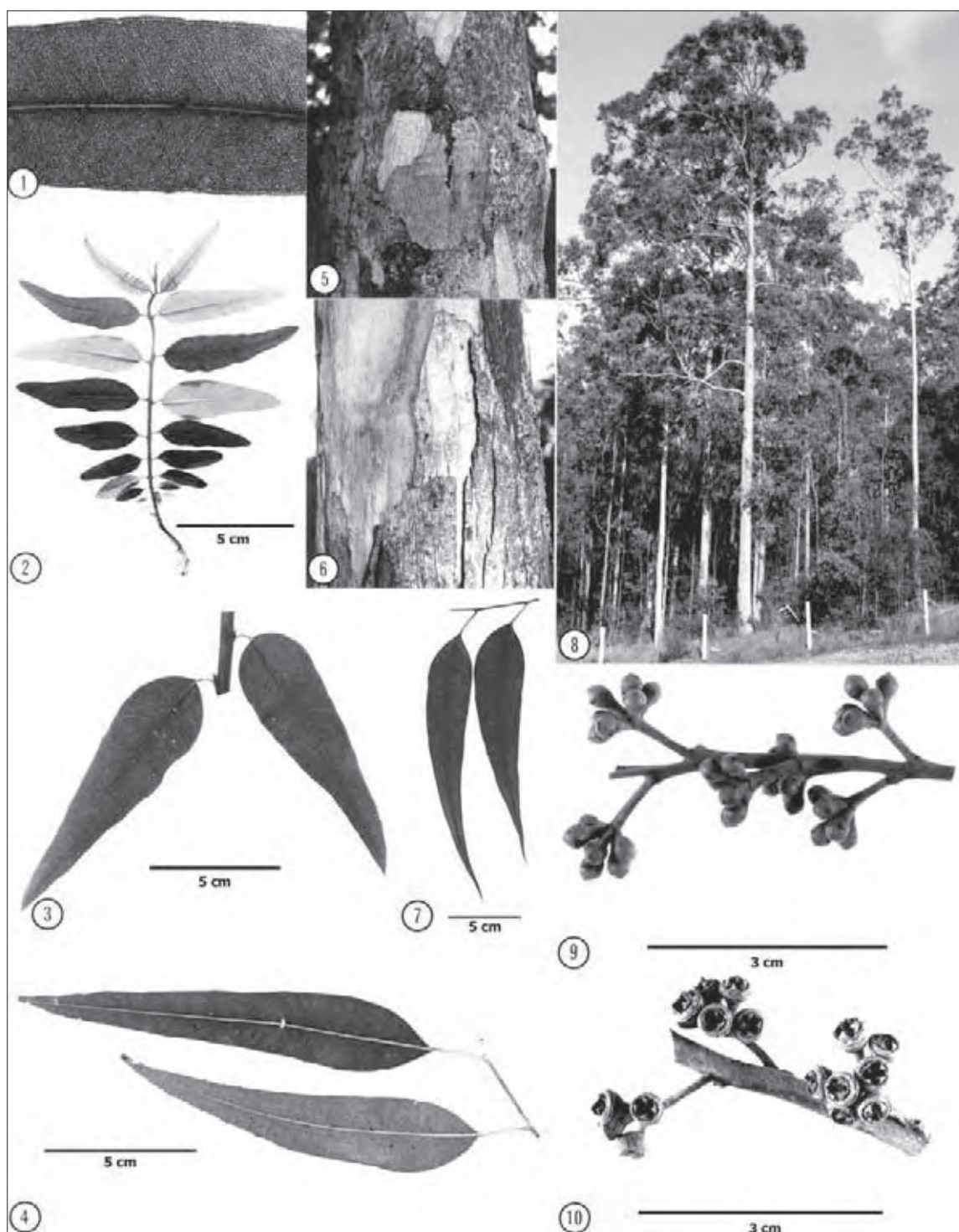
Inflorescences: Mostly simple, axillary, though sometimes also in terminal clusters, 7 to 15-flowered (*propinqua*), 7-flowered (*major*); peduncles flattened, 0.5–1.5 cm long; pedicels angular, 0.2–0.5 cm long (*propinqua*), absent or up to 0.4 cm long (*major*); buds ovoid or clavate, 0.4–0.5 × 0.3 cm (*propinqua*), 0.6–1.1 × 0.3–0.5 cm (*major*), often with ribs on hypanthia continued from pedicels; operculum hemispherical and apiculate, or occasionally conical (*propinqua*) or low conical to rostrate and up to 1× times hypanthium length (*major*). Flowers Jan.–Mar.

Fruits: Pedicellate (*propinqua*), sessile or pedicellate (*major*), obconical to hemispherical, often with ribbed hypanthia (particularly in *major*), 0.25–0.5 × 0.3–0.6 cm (*propinqua*), 0.4–0.7 × 0.6–0.8 cm (*major*); disc moderately broad, more or less level or ascending; valves 3 or 4, exserted (quite strongly in the case of *major*). A whitish skin (pellicle) is often visible over the disc and valves. Seeds pyramidal, dark brown to black, hilum terminal.

Wood: Sapwood pale red, seldom attacked by *Lyctus* borers; heartwood red to red-brown, coarse but uniform in texture, with interlocked grain, very hard, strong, tough and extremely durable; density 945–1105 kg m⁻³; a prime structural timber used for heavy engineering, poles and railway sleepers.

Climate: Altitudinal range: near sea level to 900 m; Hottest/coldest months: 24–31°C/3–10°C; Frost incidence: low to moderate (up to 10 each year at high elevation sites); Rainfall: 850–1700 mm per year, summer max.

Distinctive features: Gum-barked trees with bark shed irregularly to leave a colourful, patchy, granular surface; leaves discolorous with many side veins; inflorescences 7 to 15-flowered, mostly axillary, but sometimes terminal; fruits small, with exserted valves; either lignotuberous (*major*) or non-lignotuberous (*propinqua*).



Eucalyptus propinqua 1. Adult leaf venation 2. Seedling 3. Juvenile leaves 4. Adult leaves 5, 6. Bark 7. Intermediate leaves 8. Tree, between Kempsey and Telegraph Point, N.S.W. 9. Buds 10. Fruits

Grey Gum Large-fruited Grey Gum

Eucalyptus punctata DC. (and allies *E. biturbinata*, *E. longirostrata*, *E. canaliculata*)

These are large-fruited grey gums and forest trees of good form, which attain up to 35 m in height and 1 m dbh. On poorer soils they may be reduced to less than 10 m in height, with a deep, much branched crown.

Grey gums occur in central eastern New South Wales from south of Nowra to the Liverpool Range (*E. punctata*), the northern coastal ranges and near Long Point south-east of Armidale in New South Wales extending north to west of Gympie in Queensland (*E. biturbinata*), north of Toowoomba and Gympie and as far as the Blackdown Tableland in Queensland (*E. longirostrata*) and in the Gloucester–Dungog region of New South Wales (*E. canaliculata*).

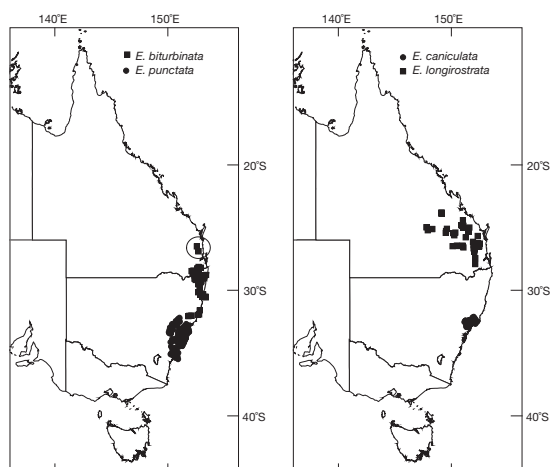
They grow on low hills and ridges of undulating country adjacent to the coast and on the ridges and slopes of the tablelands on a wide range of substrates. Some habitat specificity is apparent in *E. canaliculata* (ridge tops), *E. longirostrata* (sloping sites and shallow soils derived from sandstone) and *E. punctata* (most common on the transition zone between sandstones and shales). Soils range from moderately fertile loams to almost skeletal types.

Grey gums occur in open or tall open eucalypt forests in association with a large number of species. These include forest red gum (*E. tereticornis*), bloodwoods (*E. gummifera*, *E. intermedia*), white stringybark (*E. globoidea*), ironbarks (*E. paniculata*, *E. crebra*), blackbutt (*E. pilularis*), spotted gum (*E. maculata*), *Angophora* spp., and white mahoganies (*E. acmenoides*, *E. umbra*).

Related species: Grey gums belong in series *Lepidotae-Fimbriatae* (Brooker 2000). They fall into two groups, the small-fruited grey gums which are also characterised by the bark shedding in strips and the brown seeds (e.g. *E. propinqua*), and the larger-fruited grey gums whose bark sheds in large plates and has black toothed seeds. Populations from the Consuelo Tableland and Carnarvon Range in central Queensland were recognised as *E. grisea* by Hill and Johnson (2000), based on their broad juvenile and adult leaves, beaked opercula and flattened peduncles.

Publication: *E. punctata*: DC. *Prodr.* 3, 217 (1828). Type: Nova Hollandia, F.W. Sieber, 623. *E. biturbinata*: *Flora Australia* p. 507. Type: Kyogle, 3 miles [c. 5 km] N of Cawongla, New South Wales, 14 Jan. 1966, R.D. Johnston 149 and A. Nichols. *E. longirostrata*: *Fl. Aust.* p. 509 (1988). Type: Benarkin, Queensland, 1917, Forest Inspector Twine. *E. canaliculata*: *J. Proc. Roy. Soc. N.S.W.* 54, 171 (1920). Type: near Dungog, New South Wales, Sep. 1920, A. Rudder and J. Boorman.

Names: Botanical—*punctata*, Latin *punctatus* (dotted, spotted), of the leaf glands; *biturbinata* Latin *bi-* and *turbinatus* (two and top-shaped), supposedly in reference to the conspicuous double opercula; *longirostrata*, Latin *longus* (long), *rostratus* (beaked), of the opercula; *canaliculata*, Latin *canaliculatus* (canaliculate, i.e. with a longitudinal channel or groove), presumably in reference to the fruits. Common—refers to the colour of the bark after weathering.



Bark: Decorticating irregularly to expose a cream to bright orange surface which weathers to grey and dark grey or grey-brown with a granular surface. Blaze pink or orange (*longirostrata*).

Leaves: Seedling—opposite for a few pairs then alternate, petiolate, variable in shape from narrow-lanceolate to ovate, 4–11.5 × 0.6–4 cm, green, discolorous. Juvenile—alternate, petiolate, lanceolate to ovate, 5.5–18 × 1.5–5 cm, green, discolorous. Intermediate—alternate, petiolate, lanceolate to broad-lanceolate, 11–19 × 3–4.5 cm, green, discolorous. Adult—alternate, petiolate, lanceolate to broad-lanceolate, 5–18 × 1.4–5 cm, green, discolorous.

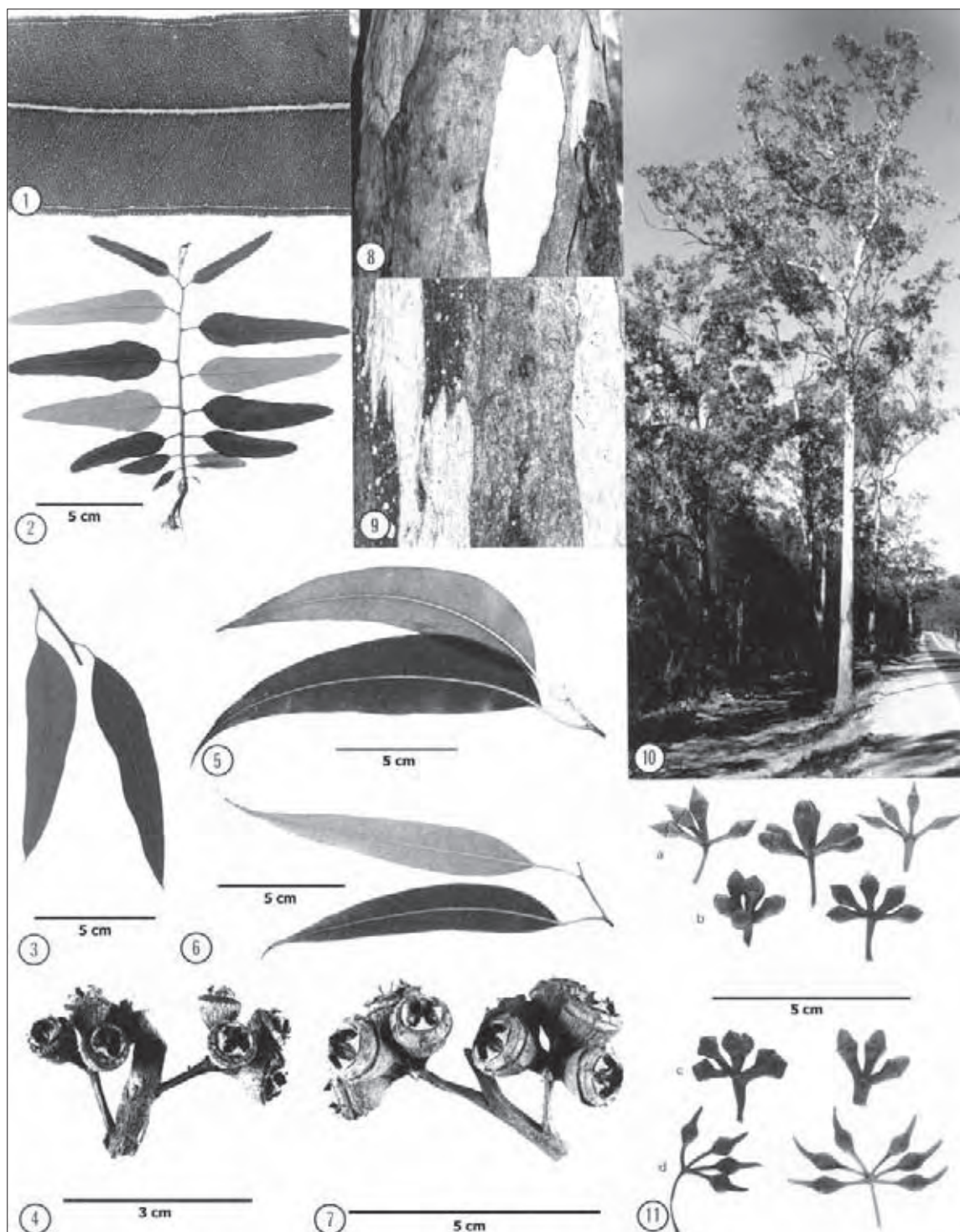
Inflorescences: Mostly simple, axillary though some apparently terminal clusters, 7(9)-flowered peduncles angular to flattened, 0.5–2 cm long; pedicels generally angular, 0.2–0.9 cm long (slender and elongate in *longirostrata*); buds 0.7–1.6 × 0.4–0.6 cm, hypanthia hemispherical to obconical, often ribbed or angled, opercula conical or rounded (*punctata*, *canaliculata*) or beaked (*longirostrata*) or obtuse, angular (*biturbinata*); outer operculum scar broad in *E. canaliculata*. Flowers Dec.–Apr.

Fruits: Pedicellate, cylindrical to slightly hemispherical, 0.5–1.2 × 0.5–1.5 cm; disc of medium width to broad, more or less level or ascending; valves 3 or 4, deltoid, often robust, slightly to strongly exserted, often with remnants of a whitish skin (pellicle) attached. Seeds pyramidal, black, hilum terminal.

Wood: Sapwood pale red, seldom attacked by *Lyctus* borers; heartwood red, hard, heavy, strong and extremely durable, with a coarse, uniform texture and generally interlocked grain, often marked with grub holes; density 945–1105 kg m⁻³; used for heavy engineering construction, poles and railway sleepers. Wood similar to grey gum (*E. propinqua*).

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest months: 26–33°C/1–6°C; Frost incidence: low to high (up to 40 each year at high elevation sites); Rainfall: 700–1200 mm per year, summer max.

Distinctive features: Trees with cream to orange-coloured new bark after the old dark grey bark has been shed; leaves discolorous; inflorescences mostly 7-flowered; a bottle-shaped swelling present where the lignotuber usually occurs.



Eucalyptus punctata (p), *E. biturbinata* (b), *E. longirostrata* (l), *E. caniculata* (c) 1. Adult leaf venation (p) 2. Seedling (b) 3. Juvenile leaves (p) 4. Fruits (p) 5. Intermediate leaves (b) 6. Adult leaves (p) 7. Fruits (c) 8, 9. Bark (p) 10. Tree (p), Putty Road, south-west of Singleton, N.S.W. 11. Buds (a, p; b, b; c, c; d, l)

Woollybutt

Eucalyptus longifolia Link & Otto

Woollybutt is a medium-sized to tall tree when growing in moist conditions. It attains 20–35 m in height and up to 1 m in diameter. The trunk is often only about half the total tree height but is commonly of good form. The crown is somewhat irregularly but heavily branched, with smaller pendulous branchlets. When it extends to drier sites the size is reduced and the branching heavier.

Woollybutt occurs as scattered trees in the central and southern coastal forests of New South Wales from just north of Newcastle to near the Victorian border, usually within 70 km of the coast. It is common on the South Coast of New South Wales from Nowra to Bega.

This species is found mainly in valleys and on low country where the soils do not dry out as much as on adjacent hill slopes. Woollybutt shows a preference for somewhat heavy soils and best growth is on moist but not swampy alluvials and other moderately heavy soils which are usually derived from shales.

It mainly occurs as a fairly common species fringing small streams and intermittent drainage channels or as scattered trees in open or tall open eucalypt forests. On moister sites associated eucalypts may include spotted gum (*E. maculata*), coast grey box (*E. bosistoana*), river peppermint (*E. elata*) and sometimes, bangalay (*E. botryoides*). On drier or more freely drained areas there is commonly silvertop ash (*E. sieberi*), as well as blackbutt (*E. pilularis*), various stringybarks (*E. globoidea*, *E. muelleriana*) and red bloodwood (*E. gummifera*).

Related species: Brooker (2000) placed woollybutt in a monotypic section (*Similares*) as it is not closely related to any other species. It is easily recognised by the rough bark, the large, falcate, concolorous, dull and bluish grey adult leaves and the pendulous, 3-flowered inflorescences. This combination of features makes it unique for species in New South Wales. Woollybutt was previously considered closely related to the discolorous-leaved grey gums (section *Latoangulatae*)—see Pryor and Johnson (1971).

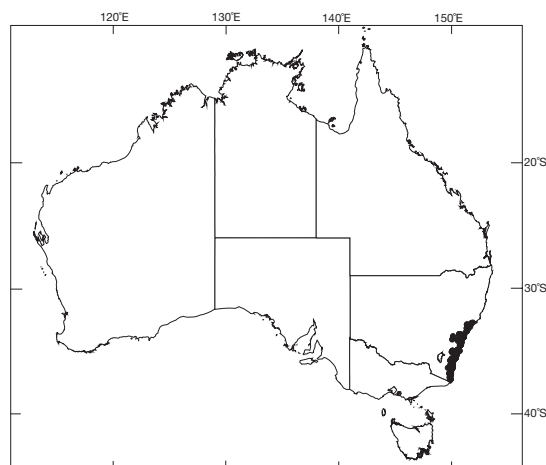
Publication: *Enum. Hort. Berol.* 2, 29 (1822). Type: probably Port Jackson, New South Wales, collector unknown.

Names: Botanical—Latin *longus* (long), *folium* (leaf). Common—refers to the bark.

Bark: Rough and persistent to the large branches, subfibrous, irregularly ridged and cracked, and tending to be thin and flaky, grey; shed from the smaller branches in irregular flakes, leaving them smooth, fawn or greenish.

Leaves: Seedling—opposite for 3 or 4 pairs then alternate, petiolate, ovate, 6.5–13.5 × 2–5 cm, greyish green, slightly discolorous. Juvenile—alternate, petiolate, ovate to broad-lanceolate, 9–21 × 4–9 cm, greyish green, slightly discolorous. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 12–24 × 2.5–4 cm, green, concolorous. Adult—alternate, petiolate, falcate or lanceolate to narrow-lanceolate, 11–24 × 1.2–2.5 cm, bluish green or greyish green, concolorous.

Inflorescences: Simple, axillary, 3-flowered; peduncles terete to slightly angled, slender, usually pendulous, 1.1–3.4 cm long;



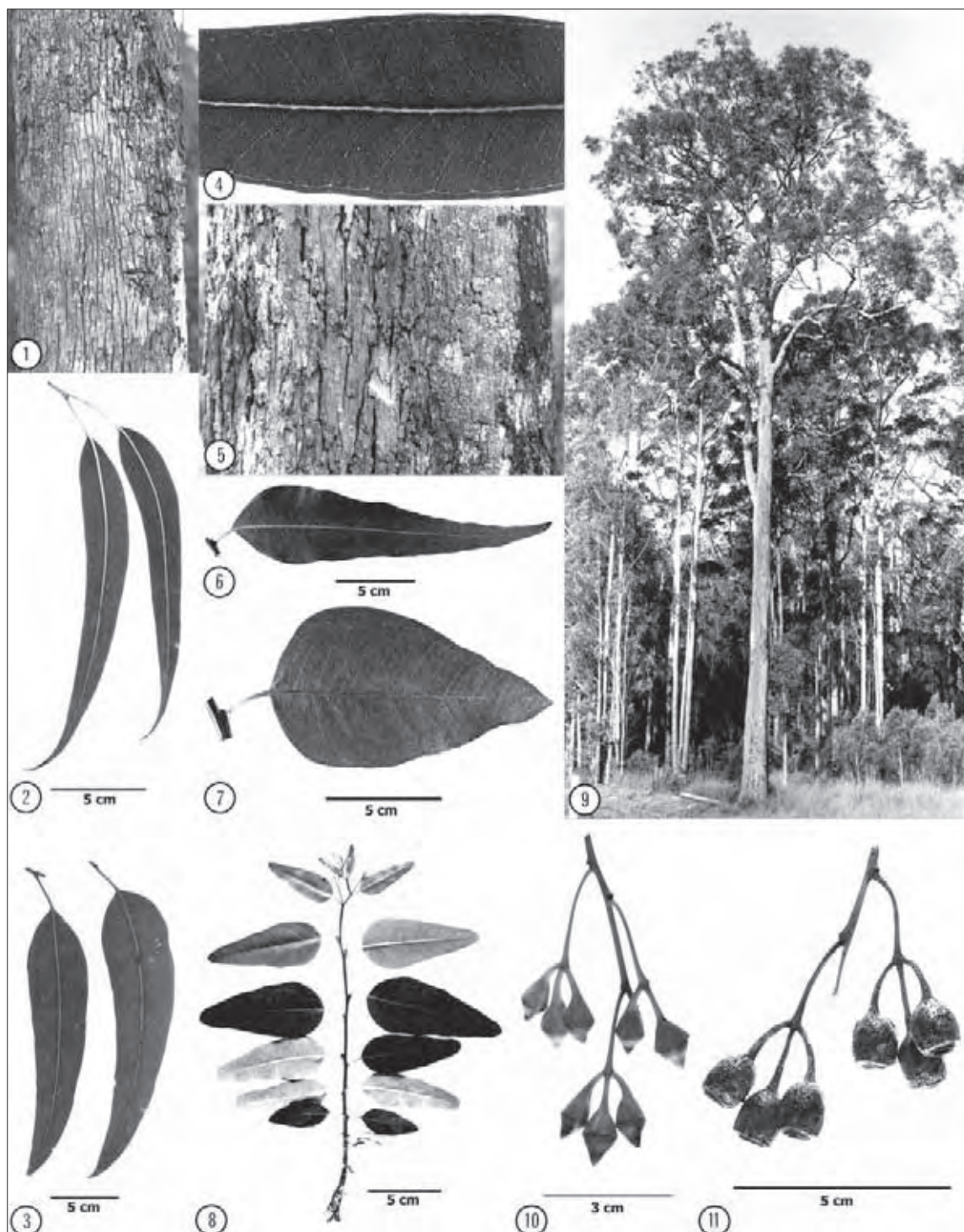
pedicels 0.4–2 cm long; buds double-conic, 1.5–2.6 × 0.6–1.2 cm, often with faintly ribbed hypanthia; opercula conical or rostrate. Flowers Oct.–Nov.

Fruits: Pedicellate, cupular, cylindrical or campanulate, 1–1.7 × 0.9–1.6 cm; disc very broad, descending vertically, rim formed by the prominent, vertical operculum scar raised to the staminal ring; valves generally 4, erect but usually below rim level or sometimes just slightly protruding. Seeds pyramidal, brown, hilum terminal.

Wood: Sapwood susceptible to attack by *Lyctus* borers; heartwood red, similar to Sydney blue gum (*E. saligna*), moderately coarse-textured and even, grain usually interlocked, moderately hard, strong, durable; density 895–1160 kg m⁻³; used for general building construction and for railway sleepers.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 24–27°C/1–8°C; Frost incidence: low to moderate (5–20 each year at high elevation sites); Rainfall: 800–1250 mm per year, summer max.

Distinctive features: Subfibrous, thin, flaking, grey bark, persistent on trunk and large branches; prominent, pendulous, 3-flowered inflorescences; long peduncles and pedicels; large buds and fruits; adult leaves long, narrow and often falcate.



Eucalyptus longifolia 1, 5. Bark 2. Adult leaves 3. Intermediate leaves 4. Adult leaf venation 6, 7. Juvenile leaves 8. Seedling 9. Tree, south of Eden, N.S.W. 10. Buds 11. Fruits

■ Red Gums

Eucalyptus section *Exsertaria* L.D. Pryor & L.A.S. Johnson ex Brooker

The red gums are a large and fairly distinctive group. They fall into six taxonomic series (Brooker 2000). One of the series (*Subexsertae*) is exclusively northern and includes *E. platyphylla* and *E. herbertiana*. These might generally be called the northern red gums. Another series (*E. series Erythroxylon* (Blakely) Brooker), might be referred to as the southern (and eastern) red gums, although several of the species have a wide latitudinal range.

One species, river red gum (*E. camaldulensis*) is the most widespread in the genus and is found, particularly along river banks, over most of continental Australia apart from the eastern ranges and coastal plains, where it is replaced by forest red gum (*E. tereticornis*), the Nullarbor region and the south-west of Australia where it is replaced by another red gum, moitch (*E. rudis*).

The red gums may be mallees, e.g. Dwyer's red gum (*E. dwyeri*), or tall, erect forest trees, e.g. forest red gum (*E. tereticornis*), or spreading woodland trees, e.g. white gum (*E. platyphylla*) and Blakely's red gum (*E. blakelyi*). They occupy a wide variety of habitats, e.g. Kimberley white gum (*E. houseana*) grows only on the banks of streams, whitebark (*E. apodophylla*) prefers poorly drained flats and swamps, while Kalumburu gum (*E. herbertiana*), tumbledown red gum (*E. dealbata*) and Queensland peppermint (*E. exserta*) are found usually on well-drained, rocky sites.

The red gums are so-named because of the red colour of the timber of most species although the heartwood of the northern species tends to be brown. Both river red gum and forest red gum are important commercial species in Australia and overseas producing strong, hard, heavy and durable timber. It is used for structural purposes, posts, charcoal, paper and fuel.

Botany

The bark of most species is smooth and seasonally deciduous but in three species the outer bark

is not shed and varies from somewhat fibrous in grey mallee (*E. morrisii*) and Queensland peppermint (*E. exserta*) to hard and furrowed in Cape York red gum (*E. brassiana*). The northern red gums, e.g. *E. platyphylla* and the northern form of *E. camaldulensis*, tend to have relatively even-coloured bark, brilliant coppery in *E. tintinnans*, while in the other species the decortivating bark sheds in large slabs over the trunk but not all at the same time. The differing amount of weathering to which the exposed new bark is subjected results in a mosaic of colours such as cream, grey, dark grey and reddish. The older exposed bark usually becomes somewhat granular like that in the grey gums. Another small group of species, *E. section Liberivalvae*, which includes *E. bancroftii* and shares the bark character with the red gums and grey gums has traditionally been placed with the red gums, but is now considered to be sufficiently different in the fruit and seed characters.

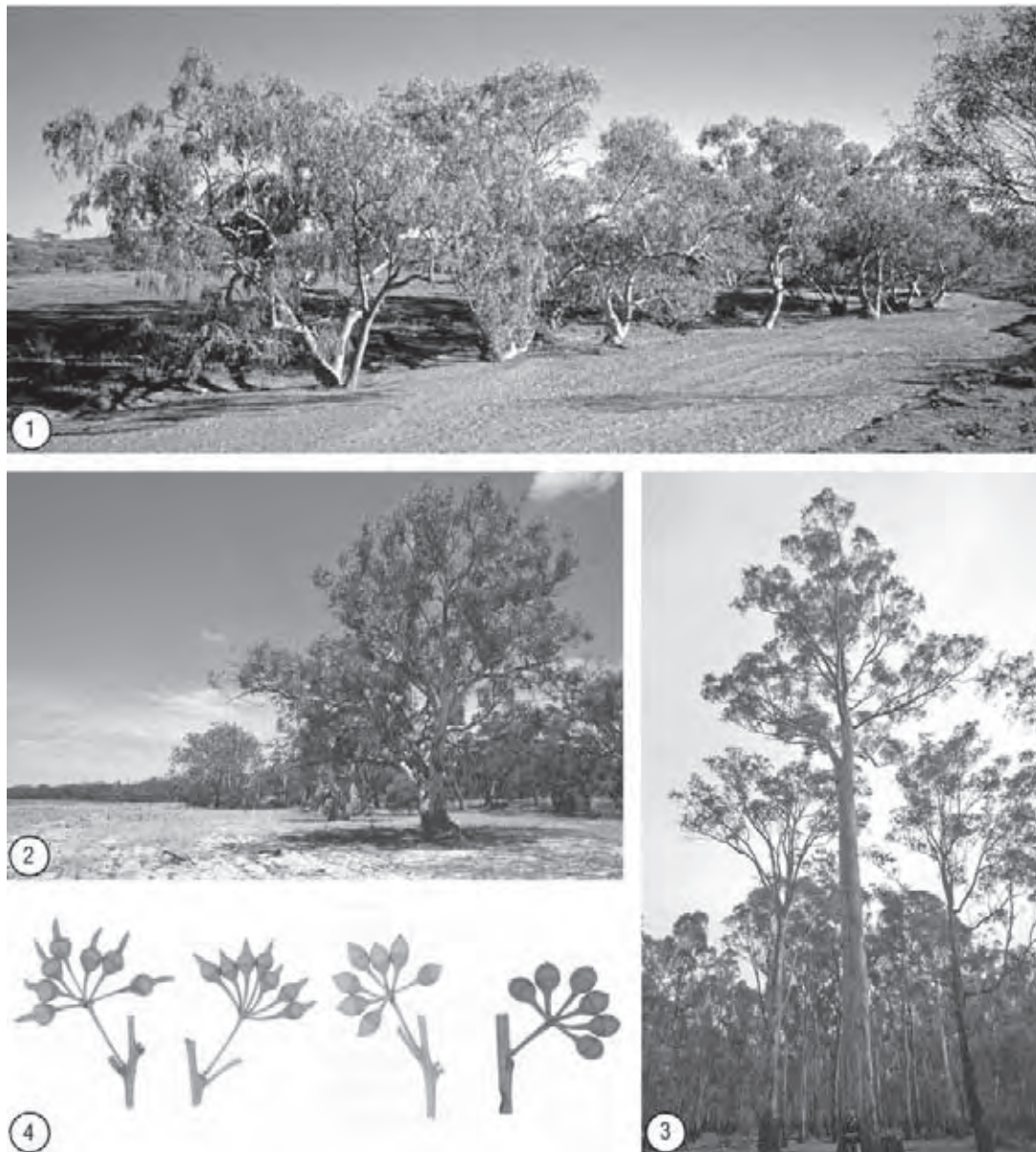
The venation of the leaves of southern and eastern red gums is rather characteristic. The prominent side veins are irregularly spaced and not great in number. The degree of reticulation is moderate (compared with that in boxes) and several glands, often appearing white, yellow and green in the fresh leaves, occupy a single areole. The leaf reticulation of the northern red gums is denser, and oil glands are often apparently absent and, if present, are intersectional.

The section *Exsertaria* is divided into series based mainly on seed characters. The best-known species, *E. camaldulensis* of series *Rostratae* (Blakely) Brooker, is notable for the smooth, yellow to yellow-brown seeds with a double seedcoat. The well-known red gum of the eastern seaboard, *E. tereticornis* of series *Erythroxylon*, has pitted, black seeds with a single seedcoat. Series *Phaeoxylon* has similar seeds, but differs by the hard rough bark as seen in *E. exserta*. *E. rudis* of Western Australia appears to be the remote, far south-western extension of the red gums. With its single-coated seeds, it is isolated by *E. camaldulensis* from other red gums with the single seedcoat, i.e. the eastern groups represented by *E. tereticornis* and *E. exserta*.

Internal bud characters are important in distinguishing the red gums. For example, *E. tereticornis* and related species with their conical opercula, have erect stamens, *E. camaldulensis* of the Murray–Darling river system has inflexed stamens, while arid zone and northern forms of the species have erect stamens. The species of series *Subexsertae* divide into two groups,

E. platyphylla having inflexed stamens, *E. herbertiana* having erect or incurved stamens.

Exsertaria received the name because of the exserted valves of the fruits, but the prominence of the valves varies between species; for example, they are strongly exserted in *E. camaldulensis*, and slightly exserted or to about rim level in *E. tintinnans*).



River red gum (*Eucalyptus camaldulensis*) is widespread, polymorphic and one of the most widely cultivated eucalypts. 1. A typical stand of the arid zone form growing along a sandy seasonal creek near Tibooburra, N.S.W. 2. The Murray-Darling Basin form at Lake Albacutya, Victoria, which is a seed source in demand due to its favourable growth and adaptability when cultivated. 3. An exceptionally tall tree of the Murray-Darling Basin form on a floodplain at Barmah State Park, Victoria (image: O. Strewé). 4. Variation in buds among these two forms (left: Murray-Darling form; right: arid zone form).

White Gum Poplar Gum

Eucalyptus platyphylla F. Muell.

White gum varies from a small, stunted tree sometimes less than 7 m in height to a tree over 20 m in height and 0.7 m dbh, with a moderately straight trunk half the total height. The crown is moderately large, but sparsely branched. Trees are often deciduous or semi-deciduous during the dry season.

White gum occurs in the tropical regions along the eastern coast of Queensland northwards from Rockhampton. The typical form of the species comes from Timor and neighbouring islands. It is also found in the Port Moresby area of Papua New Guinea and farther eastwards.

White gum attains its best development on flats and gently undulating country near the sea or watercourses (some of which may be seasonal), where the soil remains moist, even during the dry season. In these areas the soil is alluvial, heavy and may be waterlogged for most of the rainy season. It also extends to adjacent gentle slopes where soils in such areas are frequently skeletal, derived from granites or sandstones.

This species grows in woodlands or open forests and occurs with many other eucalypts. It may be associated with numerous bloodwoods and ghost gums (e.g. *E. clarksoniana*, *E. grandifolia*, *E. confertiflora* and *E. tessellaris*), Darwin woollybutt (*E. miniata*), Molloy red box (*E. leptophleba*), forest red gum (*E. tereticornis*) and other genera.

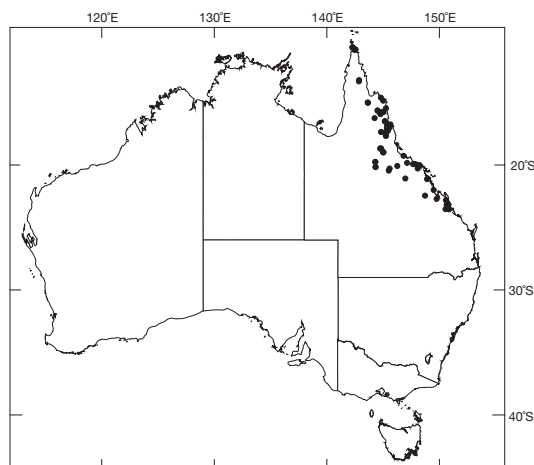
Related species: Brooker (2000) placed white gum in the northern red gums (series *Subexsertae*). The name *E. alba*, a species indigenous to Timor, has been used for Queensland populations of white gum but the distinctions between the two are unclear. More research is needed to resolve variation and nomenclature in series *Subexsertae*. Northern salmon gum (*E. bigalerita*), from tropical north-western Australia, is probably its closest relative and differs in having glossy adult leaves and larger buds and fruits. White gum is related to *E. tintinnans*, a smaller tree of hilly and rocky sites in the northern part of the Northern Territory, which differs by stature, and smaller adult leaves, buds and fruits. We do not include the narrow-leaved *E. alba* var. *australasica* in *E. alba*.

Publication: *J. Proc. Linn. Soc. Bot.*, 3, 93 (1859). Type: Upper Burdekin River, Queensland, 1856, F. Mueller.

Names: Botanical—Greek *platyphyllos*, broad-leaved. Common—refers to the bark although whiteness is very seasonal.

Bark: Newly exposed bark white or cream, weathering to very colourful pink or coppery, finally fading to whitish grey; the white surface is dull and covered by a powdery bloom.

Leaves: Seedling—opposite for 3–7 pairs then alternate, petiolate, ovate to suborbicular, 5–14 × 3–11 cm, green or dull greyish green, concolorous or slightly discoloured. Juvenile—alternate, petiolate, ovate to suborbicular to deltoid, often somewhat cordate, 7–25 × 4.5–20 cm, green or dull greyish green, concolorous or slightly discoloured. Intermediate and adult—alternate, petiolate, ovate to deltoid, 5–16 × 5.5–9 cm, dull green, concolorous.



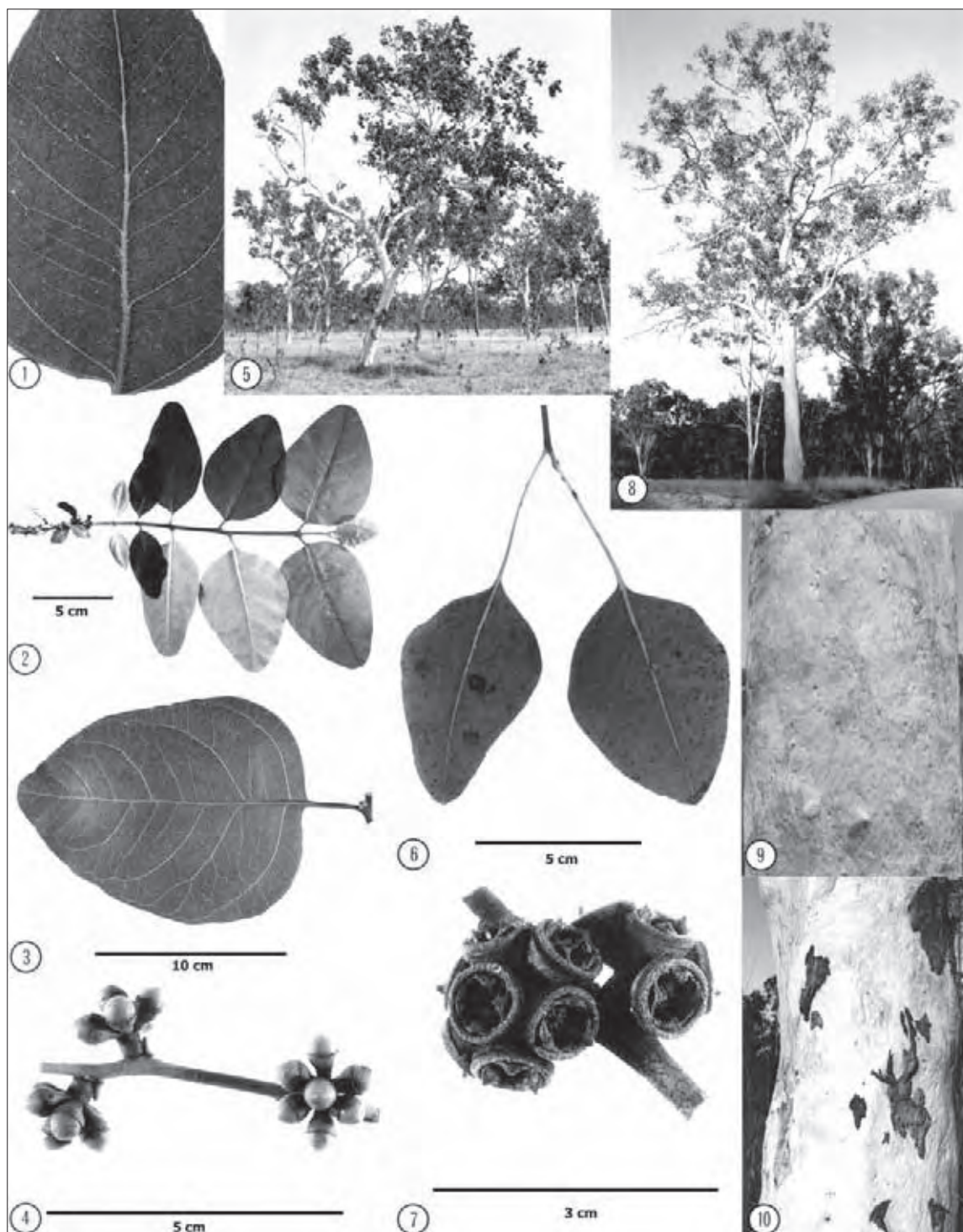
Inflorescences: Simple, axillary, 7-flowered; peduncles stout, more or less terete or slightly angular, 0.4–1.4 cm long; pedicels stout, angular (the angles continuing along the hypanthia), 0.1–0.7 cm long or occasionally absent; buds globular to ovoid, 0.4–1.2 × 0.6–1.1 cm; opercula low conical or hemispherical, sometimes apiculate. Flowers Aug.–Nov., often while trees are leafless.

Fruits: Generally pedicellate, sometimes sessile, hemispherical or obconical, 0.4–0.9 × 0.5–1.2 cm; disc of moderate width, more or less level or descending, often convex; valves 3 or 4, about rim level or exserted. Seeds elongated, cuboid or pyramidal with toothed edges, grey-black, hilum terminal.

Wood: Heartwood pinkish brown to reddish brown, grain almost straight to interlocked, rarely wavy, texture fine to moderately fine, moderately hard, heavy, strong but not very durable; susceptibility to *Lyctus* not known, not resistant to termite attack, density 940–1090 kg m⁻³; possibly used occasionally for firewood.

Climate: Altitudinal range: near sea level to 920 m; Hottest/coldest months: 28–38°C/8–21°C; Frost incidence: low; Rainfall: 530–1900 mm per year, summer max.

Distinctive features: Bark shed usually to ground level, brilliant coppery in season, often with a white powdery bloom; juvenile leaves conspicuously ovate to suborbicular or deltoid; buds with prominent operculum scar. The species is one of relatively few in the genus that are partially to almost wholly deciduous during the dry season.



Eucalyptus platyphylla 1. Adult leaf venation 2. Seedling 3. Juvenile leaf 4. Buds 5. Trees, north Qld 6. Adult leaves 7. Fruits 8. Tree, near Herberton, Qld 9, 10. Bark

Northern Salmon Gum Adelaide River White Gum

Eucalyptus bigalerita F. Muell.

Northern salmon gum is a medium-sized tree attaining heights up to 15 m and dbh of 0.7 m. Form varies from an upright tree with a reasonably straight trunk one-third to one-half of the tree height and a rather compact and dense crown, to a crooked tree with a leaning trunk and a spreading, irregular crown.

This species occurs in the north-western part of the Northern Territory, from Darwin and the adjacent islands southwards to Daly Waters, with occurrences around the coast and islands off north-east Arnhem Land, and also in the northern part of the Kimberley region of Western Australia where it extends from near Derby to Wyndham.

The main habitat is coastal plains near rivers, but it extends to adjacent, gentle slopes. The soils are typically alluvial and vary from deep, sandy lateritic clay loams to somewhat heavy clays. Most of the sites are subject to inundation during the monsoon season.

Northern salmon gum grows in open forests or commonly as scattered specimens in woodlands. Associated eucalypts include Darwin stringybark (*E. tetradonta*), large-leaved cabbage gum (*E. grandifolia*), smooth-barked bloodwood (*E. foelscheana*), apple gum (*E. polyclada*) and Darwin box (*E. tectifica*).

Related species: Brooker (2000) placed northern salmon gum in the northern red gums series *Subexsertae*. It is closely related to *E. tintinnans*, a smaller tree of hilly and rocky sites in the northern part of the Northern Territory, which differs by stature, and smaller adult leaves, buds and fruits. White gum (*E. alba*), from Timor, is probably its closest relative and differs in having dull adult leaves and smaller buds and fruits. It is more distantly related to *E. alba* var. *australasica*, which occurs in the northern parts of Northern Territory and the Kimberley region of Western Australia, which can be readily distinguished by its narrow lancolate leaves.

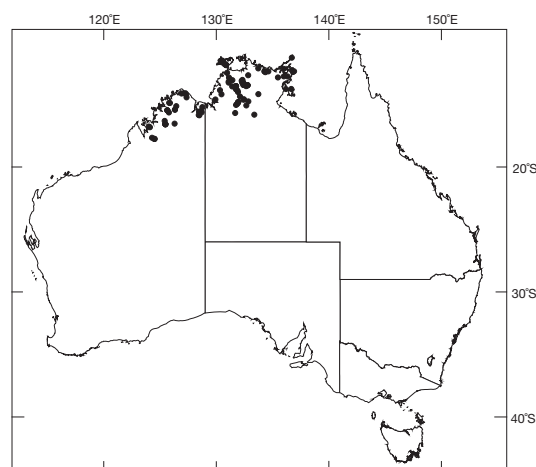
Publication: *J. Linn. Soc. Bot.* 3, 96 (1859). Type: West of Mataranka, Northern Territory, Jul. 1856, F. von Mueller.

Names: Botanical—Latin *bi* (two), *galerum* (cap, helmet), refers to the double opercula. Common—refers to habitat in northern Australia and to bark colour.

Bark: Decorticating to near ground level. It is shed early in the dry season and the smooth, newly exposed surface may at first be whitish, but later becomes cream, salmon-coloured or light khaki.

Leaves: Seedling—opposite for 5 or 6 pairs then alternate, petiolate, ovate to suborbicular, 5–14 × 3–11 cm, dull greyish green, concolorous. Juvenile—alternate, petiolate, ovate to suborbicular, often somewhat cordate, 13–18 × 12–16 cm, dull greyish green, concolorous. Intermediate and adult—alternate, petiolate, ovate or deltoid, 6–15 × 5.5–9 cm, glossy green, concolorous.

Inflorescences: Simple, axillary, 7-flowered; peduncles stout, angular, 0.8–1.4 cm long; pedicels either absent or very short, stout, angular, 0.1–0.3 cm long, with ribs continuing up the hypanthia and outer opercula (not distinct on inner opercula);



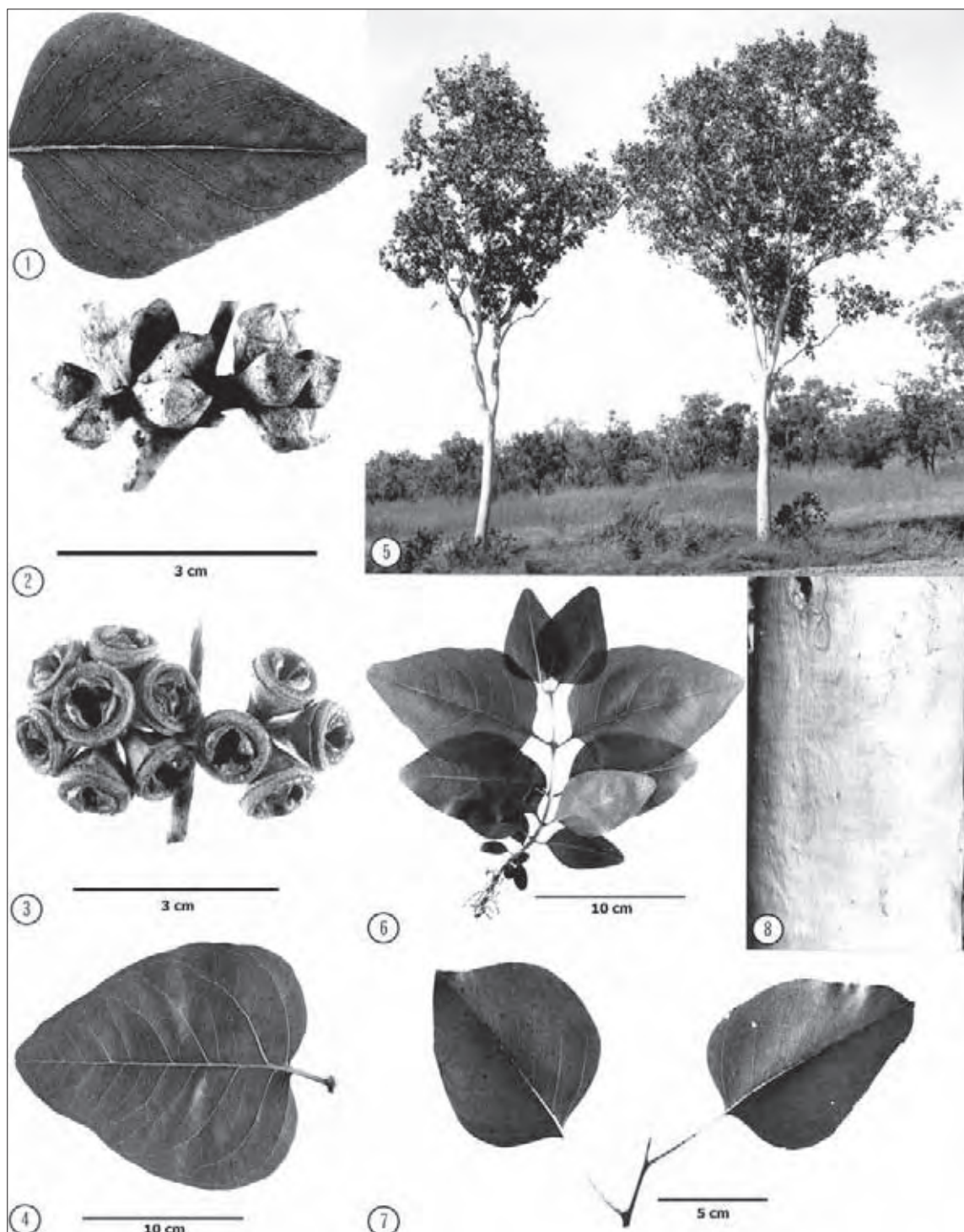
buds ovoid to sub-globular, 0.8–1.2 × 0.6–1.1 cm; opercula hemispherical, sometimes apiculate. Flowers Jul.–Aug.

Fruits: Sessile or very shortly pedicellate, more or less hemispherical or broadly obconical, 0.5–0.9 × 0.6–1.2 cm; disc more or less level or descending; valves 4, short, broad, about rim level or slightly exserted.

Wood: Reputedly soft and of poor quality.

Climate: Altitudinal range: near sea level to mainly less than 200 m; Hottest/coldest months: 33–39°C/11–19°C; Frost incidence: low; Rainfall: 600–1500 mm per year, summer max.

Distinctive features: Adult and intermediate leaves large, glossy, deltoid, long-stalked; 7-flowered shortly pedicellate inflorescences; large subglobular buds and hemispherical to obconical fruits.



Eucalyptus bigalerita 1. Adult leaf venation 2. Buds 3. Fruits 4. Juvenile leaf 5. Trees, south of Katherine, N.T.
6. Seedling 7. Adult leaves 8. Bark

Migum (W.A.) Snappy Gum (N.T., Qld)

Eucalyptus leucophloia Brooker

Migum is a small tree to 10 m in height and 40 cm dbh, often with a characteristically crooked trunk, branching heavily at quarter to half tree height. In typical open-growing conditions, the moderately dense crown is often as wide as the tree is high. There are two subspecies, the typical and subsp. *euroa*.

Typical migum (subsp. *leucophloia*) occurs in the Hamersley Ranges and east to the Rudall River region of central-northern Western Australia, while subsp. *euroa* occurs in the Northern Territory from Victoria River Downs eastwards to Tennant Creek, and to Mt Isa and Cloncurry and south to Dajarra in north-western Queensland.

This small tree is commonly found on rugged ranges, plateaux, the slopes of small hills and the undulating country at the base of the hills, but it rarely extends on to the flat. The soils are often skeletal or gravelly sands, but the species grows on a wide range of types, including red sands and, to some extent, red, brown and grey clays. Snappy gum is often associated with Proterozoic rocks including ironstone and quartzite.

Migum occurs in low woodlands and often forms pure stands over an understorey of spinifex (*Triodia* spp.) and various *Acacia* spp. It is sometimes associated with other eucalypts such as tjuta (*E. terminalis*), warilu (*E. gamophylla*) and Sturt Creek mallee (*E. odontocarpa*).

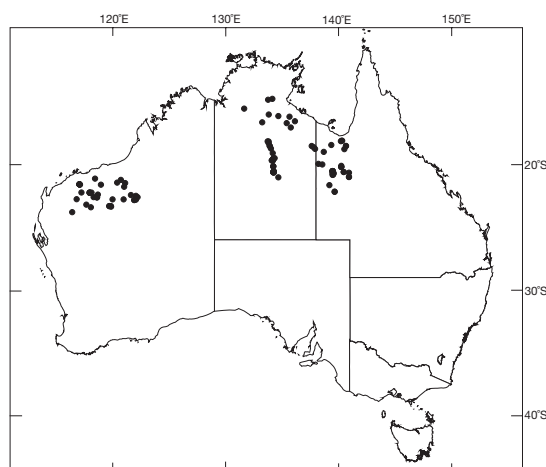
Related species: Brooker (2000) placed migum in section *Platysperma*—a group of six species. This section is quite distinct from the northern red gums, series *Subexsertae* where they had been informally placed by Pryor and Johnson (1971). The group differs from the typical red gums by the flattish seeds with a ventral hilum. Migum is related to northern white gum (*E. brevifolia*) and Kimberley gum (*E. confluens*), which have characteristically more robust fruits with a prominent disc. Migum has dull adult leaves like those of *E. brevifolia*, which has a more northern distribution, and is easily distinguished from the Kimberley endemic, *E. confluens*, which has glossy green leaves. Subsp. *euroa* is distinguished from typical migum by the steeply raised and prominently exerted valves of its fruits.

Publication: *E. leucophloia*: Nuytsia 2, 112 (1976). Type: Near Rudall River, towards the eastern end of its main W.A. occurrence, 22 May 1971, A.S. George 10782. Subsp. *euroa* L. A.S. Johnson & K.D. Hill: *Telopea* 8, 520 (2000). Type: 34 km S of Macarthur River crossing on Tablelands Highway, Northern Territory, 6 Aug. 1984, K.D. Hill 1023, L.A.S. Johnson, D. Benson.

Names: Botanical—Greek, *leukos* (white) and *phloeos* (bark); Latin *eurous* (eastern). Common—of Aboriginal origin.

Bark: Decortivating to ground level to leave a white or pinkish, powdery surface, often black-spotted.

Leaves: Seedling—opposite, petiolate, first 3 or 4 pairs ovate-lanceolate, 1–3 × 0.5–1.5 cm, then orbicular, 4–7 × 3.5–6 cm, blue-grey, slightly discolourous. Juvenile—subopposite, petiolate, broadly ovate-lanceolate, 5–7 × 3–5 cm; blue-grey. Intermediate—alternate, petiolate, broad-lanceolate,



5–7 × 2.5–3.5 cm, blue-grey. Adult—alternate or less commonly opposite, petiolate, lanceolate, 5–10 × 1–2 cm; dull, yellowish green, blue-grey or bluish green.

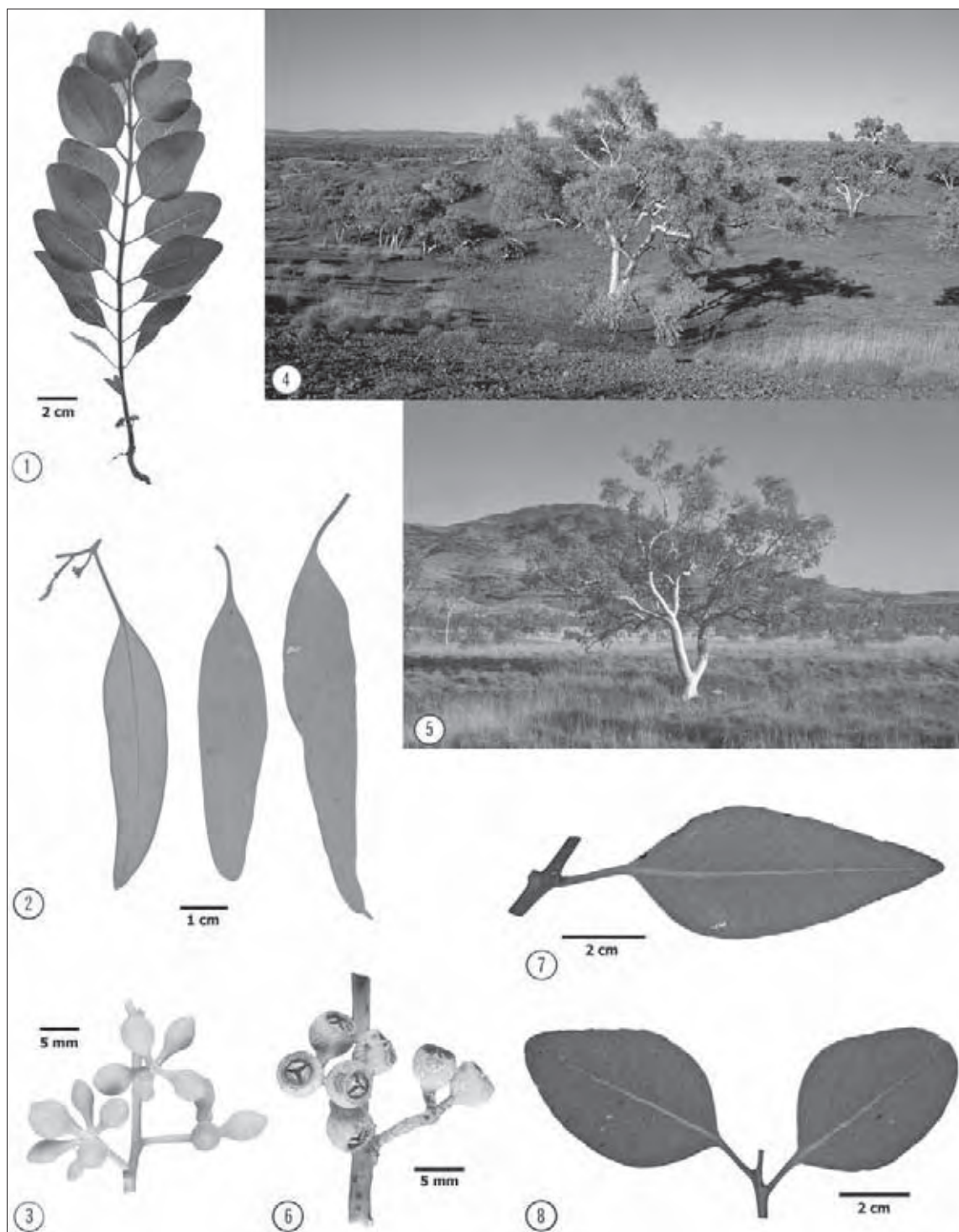
Inflorescences: Simple, axillary or sometimes clustered towards ends of branches, 7 to 11-flowered, often among intermediate foliage; peduncles somewhat slender, 0.4–1 cm long; pedicels 0.2–0.3 cm long; buds ovoid to double-conic, 0.5–0.9 × 0.3–0.5 cm; opercula hemispherical, conical or slightly rostrate, about same length as width.

Fruit: Hemispherical or cupular, 0.5–0.8 × 0.4–0.6 cm; disc narrow, obscure, depressed; valves 3, deltoid and either enclosed or slightly exerted (*leucophloia*) or strongly exerted up to 2 mm (*euroa*). Seeds round to elliptical, yellow-brown, hilum ventral.

Wood: Physical properties not known, but has been used as a fuel wood in mining areas.

Climate: Altitudinal range: 60–1035 m; Hottest/coldest months: 34–40°C/7–13°C; Frost incidence: low; Rainfall: 225–400 (–820) mm per year, summer max.

Distinctive features: A small tree, with a strikingly white bark to ground level, often black-spotted. Adult leaves small and dull, blue-grey. Inflorescences 7 to 11-flowered and fruit typically hemispherical, with relatively large, deltoid, exerted valves, or cupular, with less-conspicuous valves; disc obscure.



Eucalyptus leucophloia 1. Seedling 2. Adult leaves 3. Buds 4. Stand, near Millstream, W.A. 5. Tree, near Hammersley Ranges, W.A. 7. Intermediate leaves 8. Juvenile leaves

River Red Gum Red Gum, Murray Red gum, River Gum (W.A.)

Eucalyptus camaldulensis Dehnh.

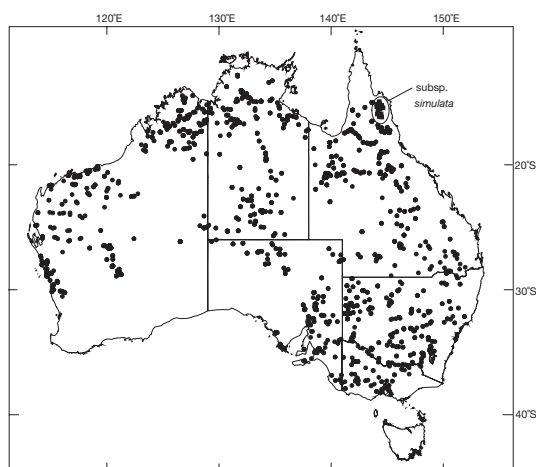
River red gum is a large-boled, medium-sized to tall tree. It is commonly up to 20 m tall, but exceeds 45 m occasionally, while the dbh is 1–2 m or occasionally up to 4 m. The crown is large, and in open formation the tree usually has a short, thick bole. There are two subspecies, the 'typical' form and subsp. *simulata*, and some poorly circumscribed varieties that warrant reappraisal (e.g. vars. *acuminata*, *obtusata*, *subcinerea*).

River red gum is the most widely distributed of all eucalypts. With the exception of the southern parts of Western Australia, the Nullarbor Plain and the coastal fringe of most of Victoria, New South Wales and eastern Queensland, it is found throughout mainland Australia. Absent from the far northern tropical fringes of the continent, it occurs along or near almost all of the seasonal watercourses in the arid and semi-arid areas and is found along many other streams and rivers in the south-east of the continent, mainly on the inland side of the Great Dividing Range. Although mainly a riparian tree it sometimes extends to floodplains (e.g. Barmah on the Murray River) and to the slopes of ranges (e.g. Mt Lofty Ranges near Adelaide and the Everard Range in north-western South Australia).

A number of forms of river red gum can be recognised over its extensive range. A form with rostrate buds occupies the Murray–Darling drainage basin, with outliers on the Hunter River system near Aberdeen, in New South Wales and areas such as Eyre Peninsula, southern Flinders Ranges and Kangaroo Island in South Australia. Intergrade populations of this form and forest red gum (*E. tereticornis*) occur where the two come into contact, e.g. on parts of the Balonne, Moonie, Maranoa and Warrego Rivers in southern Queensland. A form with conical opercula has a broad distribution outside the Murray–Darling drainage basin. It occupies the Lake Eyre drainage basin and extends west to drainage basins of Western Australia where it forms intergrade populations with moitch (*E. rudis*) where the two come into contact, e.g. the Moora area, north-east of Perth. Northern populations of the conical opercula form differ in having green adult leaves and mostly white bark. Subsp. *simulata* occurs mainly in the Laura River drainage basin in north Queensland.

Soils are alluvials, often sands and sandy loams overlying clay. On larger river systems sandy levees on river bends are common habitats but clayey riverbanks are also favoured. It grows on calcareous clay loams derived from limestone on the lower Eyre Peninsula and on York Peninsula in South Australia.

River red gum is typically a riverine species and has a ribbon-like distribution across the landscape. It usually forms woodlands, open woodlands or open forests (e.g. floodplain occurrences at Barmah, N.S.W.). While often the main tree species present, it may be associated with a range of other species including acacias (*A. stenophylla*,



A. salicina, *A. victoriae*, *A. citrinoviridis*, *A. coriacea*), eucalypts (*E. coolabah*, *E. victrix*, *E. largiflorens*), melleucas (*M. leucadendra*, *M. desertiflora*, *M. bracteata*) and casuarinas (*C. obesa*, *C. cunninghamiana*).

Related species: Brooker (2000) placed river red gum as the sole species of series *Rostratae*, which is diagnosed by the smooth, usually double-coated, yellowish seeds, compared with the pitted, black, single-coated seeds of the other series in section *Exsertaria*. Forest red gum (*E. tereticornis*) is its closest relative and the two form extensive intergrade populations where they come into contact. Forest red gum has an extensive distribution along most of coast and the adjacent subcoastal ranges of eastern Australia, extending north into Papua New Guinea. It mainly differs in having broadly ovate seedling leaves and elongated, horn-shaped opercula, which widen at the base. Blakely (1934) described a number of varieties of river red gum. The most commonly recognised is var. *obtusata*, a name usually attributed to all populations occurring beyond the Murray–Darling drainage basin. It differs by its colourful smooth bark to ground level and its obtuse opercula that have erect stamens. Var. *subcinerea*, the pruinose, bluish-leaved form is typified by populations from Silverton near Broken Hill in New South Wales. Var. *acuminata* has conical to horn-shaped opercula and occurs along some upper tributaries of the Darling River in Queensland.

Publication: *E. camaldulensis* (see discussion below regarding this name): *Cat. Plant. Hort. Camald.* 2nd edn, 20 (1832). Type: Hortus Camaldulensis, Italy (cultivated), F. Dehnhardt. Subsp. *simulata*: *Field Guide to Eucalypts*, p. 371 (1994). Type: Laura River at crossing north of Laura, 5 Nov. 1992, M.I.H. Brooker 11358 & D.A. Kleinig.

Names: Botanical—subsp. *camaldulensis*: after Camalduli, near Naples, Italy; subsp. *simulata*: Latin *simulatus* (simulating), alludes to the similarity of the operculum shape to that of *E. tereticornis*. Common—refers to its riparian habitat and to the heartwood colour.

Bark: Rough, basal stocking, with irregular longitudinal grey to black scales, smooth above, cream to white, pale grey or buff, with grey and reddish patches, shedding in strips or irregular flakes, sapling bark granular (Murray–Darling



1. River red gum: Murray–Darling form (m), subsp *simulata* (s) var. *acuminata* (a) 1. Bark (m) 2. Seedling (m) 3. Intermediate leaf (m) 4. Adult leaves (m) 5. Fruits 6. Buds A—Morgan, S.A. B—Bourke, N.S.W. (m) 7. Buds A (s) B (a) 8. Tree, Manilla, N.S.W. (m) 9. Tree, near Leura, Qld (s).

form); or smooth to ground level, white to cream with red-brown patches or mainly white to cream, sapling bark smooth (all other forms).

Leaves: Seedling—opposite for around 4–6 pairs then alternate, petiolate, lanceolate to broad-lanceolate to elliptical or ovate, 7.5–15 × 2.5–7 cm, greyish green, green or blue-green, slightly discolorous. Juvenile—alternate, petiolate, ovate to broad-lanceolate, 13–26 × 4.5–8 cm, greyish green or green or blue-green, slightly discolorous. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate or narrow-lanceolate, 10–30 × 2–6 cm, greyish green, green or bluish green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 8–30 × 0.7–2 cm, dull or slightly glossy, greyish green, green or blue-green, concolorous.

Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles angular, usually slender, 0.5–2.5 cm long; pedicels slender, 0.1–1.1 cm long; hypanthia more or less hemispherical, sometimes very squat; opercula variable, beaked or rostrate (Murray–Darling form), or conical, hemispherical, or hemispherical-apiculate (all other forms), or horn-shaped (*simulata*); buds 0.5–1.1 × 0.3–0.5 cm or up to 2 cm long (*simulata*). Flowers Dec.–Feb. (a good source of honey).

Fruits: Pedicellate, ovoid or globose (including the disc), 0.3–0.6 (hypanthia only) × 0.4–1 cm; disc broad, ascending; valves (3)4(5), robust, strongly exerted. Seeds cuboid, yellow, yellow-brown, except var. *acuminata* which are mixed with black seeds, hilum terminal.

Wood: Sapwood susceptible to attack by *Lyctus* borers; heartwood red, with fine texture and interlocked, wavy grain, hard, durable, resistant to termites; density 735–975 kg m⁻³; young plantation grown wood exhibits a very wide range of density; used for heavy construction, railway sleepers, fine furniture, flooring, framing, fencing, plywood and veneer manufacture, turnery, is an excellent firewood and is used for charcoal production; pulpwood is produced in some overseas countries. Wood is indistinguishable from forest red gum (*E. tereticornis*), although it tends to be somewhat denser.

Climate: Altitudinal range: 20–700 m; Hottest/coldest months: 26–32°C/1–7°C (Murray–Darling form), 31–32°C/15–18°C (*simulata*), 33–38°C/3–8°C (arid zone populations), 34–39°C/8–16°C (tropical populations); Frost incidence: low but up to 20 frosts a year may be experienced in southern and inland areas; Rainfall: 325–750 mm (Murray–Darling form), 900–1000 mm (*simulata*), 150–500 mm (arid zone populations), 500–1100 mm (tropical populations), winter through to summer max. (Murray–Darling form), uniform to summer max. (arid zone populations), summer max. (tropical populations, *simulata*).

Distinctive features: A relatively large riparian tree either with a basal stocking of rough bark (Murray–Darling form) or with bark smooth to ground level, the smooth bark either mostly white or white to cream with grey, bronze and reddish patches; opercula rostrate, stamens inflexed (Murray–Darling form) or opercula obtuse, stamens erect (arid zone and tropical populations) or opercula horn-shaped, stamens erect (*simulata*); seed smooth, yellow or yellow-brown, with two seedcoats or rarely mixed with black seed with single seedcoats.

The naming of river red gum

The botanical name for river red gum has had a confusing history. Species throughout the plant world have been formally named more than once in many instances. In the case of river red gum, the currently used scientific name, *E. camaldulensis*,

was published by the German botanist F. Dehnhardt in 1832. The description was based on a cultivated tree grown in the garden of the Count of Camalduli near Naples, Italy. According to the botanical collector J.B. Cleland (1956), its origin was believed to have been from seed collected from Condobolin, New South Wales, during an expedition by the botanical explorer Allan Cunningham in 1817. The trees grown from this seed at Camalduli were thought to be around 100 years old before their removal and disappearance during the 1920s. For the best part of a century the Dehnhardt description of *E. camaldulensis* also ‘disappeared’ as it apparently remained unknown to the wider botanical community.

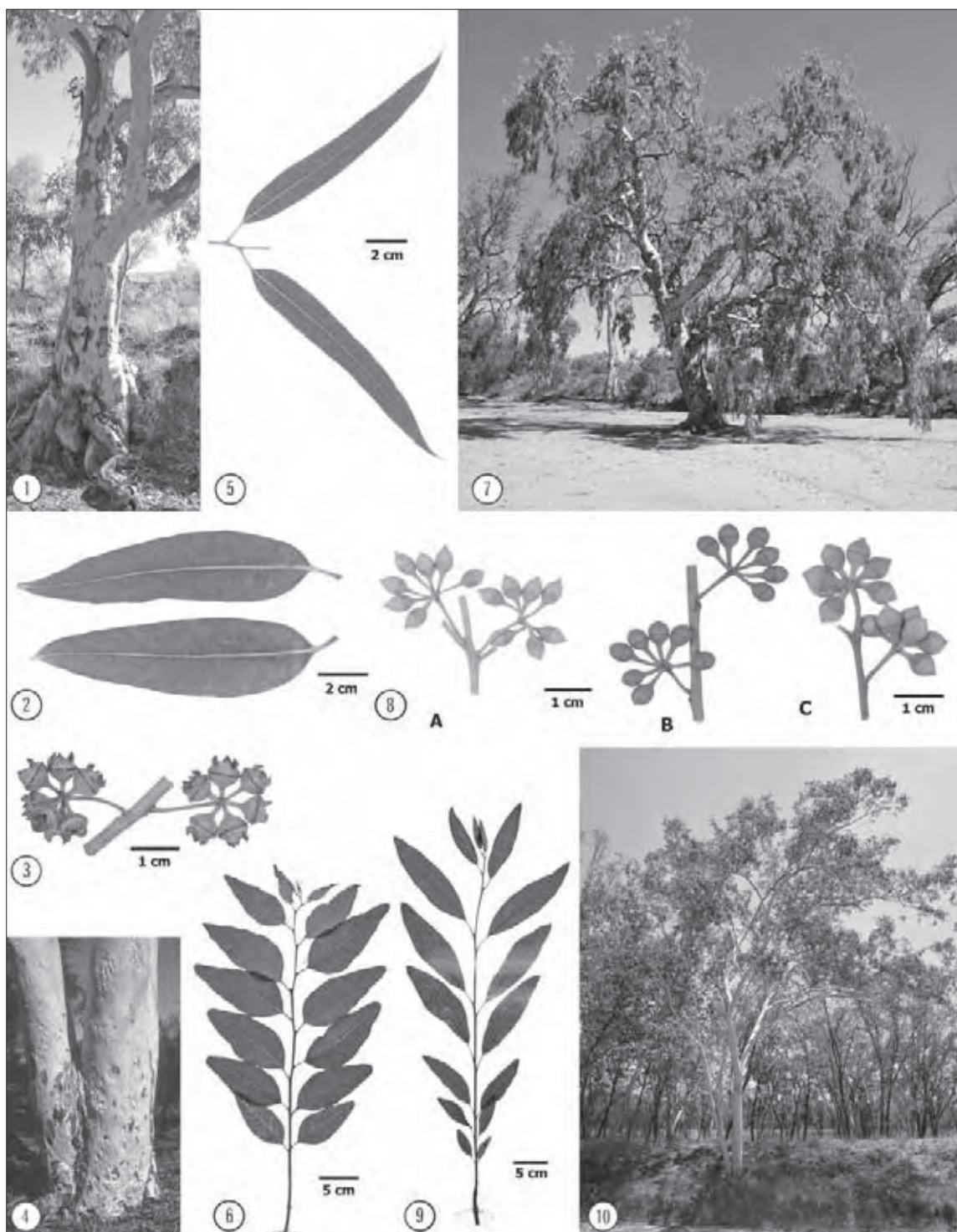
The first scientific name to become widely used for river red gum was *E. rostrata*, published in 1847 by another German botanist, D. von Schlechtendal. This was presumably published in ignorance of Dehnhardt’s earlier name. The name *rostrata* refers to the beaked operculum of the form in the Murray–Darling drainage basin of river red gum but cannot be used as it was given earlier to *E. robusta*, the currently accepted name for swamp mahogany.

During the 1850s, the prolific German botanist F. von Mueller, annotated a number of specimens of river red gum as *E. longirostris*, including some he collected in the vicinity of Beagle (sic) Range in South Australia, where he first settled after arriving in Australia. Mueller perhaps recognised that Schlechtendal’s name, *rostrata*, was illegitimate, but was unaware of the much earlier Dehnhardt publication. In 1856 the Dutch botanist, F. Miquel, formalised Mueller’s manuscript name *E. longirostris* based on specimens in the Vienna Herbarium. As a descriptive name, *longirostris*, is appropriate for the Murray–Darling drainage basin variant of river red gum.

It was not until 1920 when the name *camaldulensis* reappeared in print. In 1902 the great eucalypt botanist J.H. Maiden, who worked at Sydney Botanic Gardens, annotated the Dehnhardt type specimen as *E. rostrata* (see plate below), then later, in his *Critical Revision of the Genus Eucalyptus* (Maiden 1920), synonymised the name *camaldulensis* under *E. rostrata*, with no comment on the morphological attributes of the specimen or that it had been named earlier. W.F. Blakely, a protégé of Maiden’s, applied the rule of priority in botanical naming and revived the name *camaldulensis* for river red gum (Blakely 1934). This was despite apparently not having seen the Dehnhardt type or making comment on its morphological attributes. Since then, the name *camaldulensis* has been widely applied. The type specimen of *E. camaldulensis* is shown in the plate below. Cleland (1956) was the first to note that the buds of the type did not match the variant with beaked or rostrate buds that predominates in the Murray–Darling drainage basin.



A. The Dehnhardt type of *E. camaldulensis* B, C. Buds of the specimen enlarged.



2. River red gum: 'Arid zone' form (a), 'Northern' form (n) 1. Bark (a) 2. Intermediate leaf (a) 3. Fruits 4. Bark (n) 5. Adult leaves (a) 6. Seedling (a) 7. Tree, near Silverton, N.S.W. (a) 8. Buds A, C (a) B (n) 9. Seedling (n) 10. Tree, Gibb River, W.A. (n)

Forest Red Gum Blue Gum (Qld), Red Iron Gum (Qld)

Eucalyptus tereticornis Smith

Forest red gum is a medium-sized to tall tree attaining 20–50 m in height and up to 2 m dbh. The trunk is generally straight and clear for more than half the total height. The major limbs are often more steeply inclined than for most other eucalypt species. There are two subspecies, the widespread typical form, and subsp. *mediana*, trees of poorer form in eastern Victoria.

Forest red gum has the most extensive latitudinal distribution of the genus, extending from coastal south-eastern Victoria to southern Papua New Guinea. The northern limit in Australia is near Cooktown in northern Queensland.

In drier areas forest red gum prefers alluvial flats subject to occasional flooding. In higher rainfall areas it grows on lower slopes of hillsides and extends to mountain slopes and plateaux. It prefers fairly rich alluvial soils, sandy or gravelly loams that are moist but not waterlogged. Subsp. *mediana* occurs in wetlands in the Bairnsdale–Lakes Entrance region of Gippsland.

Typical forest red gum generally occurs in open forests or as scattered trees on alluvial flats. A diverse range of eucalypts are associated with subsp. *tereticornis* including bloodwoods (*E. tessellaris*, *E. intermedia*, *E. polycarpa*, *E. maculata*, *E. gummifera*), white gum (*E. platyphylla*), red mahogany (*E. resinifera*), ironbarks (*E. crebra*, *E. paniculata*), boxes (*E. moluccana*, *E. populnea*, *E. leptophleba*), as well as numerous other genera. Associates of subsp. *mediana* include yellow box (*E. melliodora*), blue box (*E. baueriana*) and swamp gum (*E. ovata*).

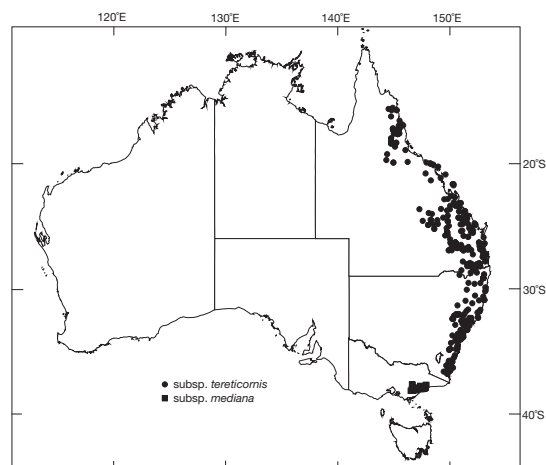
Related species: Forest red gum belongs in series *Erythroxylon* with about 15 other species (Brooker 2000). It can be difficult to separate from three tree species with which it may overlap in distribution. Blakely's red gum (*E. blakelyi*) grows on the Tablelands, and is a poorer formed tree, sometimes with pruinose buds and fruits. Cabbage gum (*E. amplifolia*) has notably greener, glossier leaves. Forest red gum and river red gum (*E. camaldulensis*) form intergrade populations where they come into contact.

Publication: Subsp. *tereticornis*: *Zoology and Botany of New Holland* 1, 41 (1793). Type: Port Jackson, New South Wales, 1793, J. White. Subsp. *mediana* Brooker & Snee: *Field Guide to Eucalypts* Vol. 1, revised 1999, (Bloomings Books), p. 345. Type: Between Metung and Swan Reach, Victoria, 18 Nov. 1993, M.I.H. Brooker 11648.

Names: Botanical—Latin *teretus* (terete, circular in transverse cross-section, tapering or narrowly conical), *cornu* (horn), in reference to the opercula; Latin *medianus* (median) refers to its morphology linking subsp. *tereticornis* and *E. camaldulensis*. Common—refers to its forest habitat and wood colour.

Bark: Shed in irregular plates leaving the surface smooth with white, grey and bluish patches corresponding to pieces of bark being shed at different times, smooth bark weathering often to granular. Frequently some rough, dark grey to black dead bark is retained at the base of the tree.

Leaves: Seedling—opposite for 3–6 pairs then alternate, petiolate, broadly ovate, 5–12.5 × 1.7–6.5 cm, dull green to



bluish green, discolorous. Juvenile—alternate, petiolate, broadly ovate, 12–22 × 4.5–10 cm, dull green to bluish green (*tereticornis*), or pruinose (*mediana*), slightly discolorous. Seedling and juvenile stems are quadrangular, flanged. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 14–25 × 2.5–5.5 cm, green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 10–20 × 1–2.7 cm, green, concolorous.

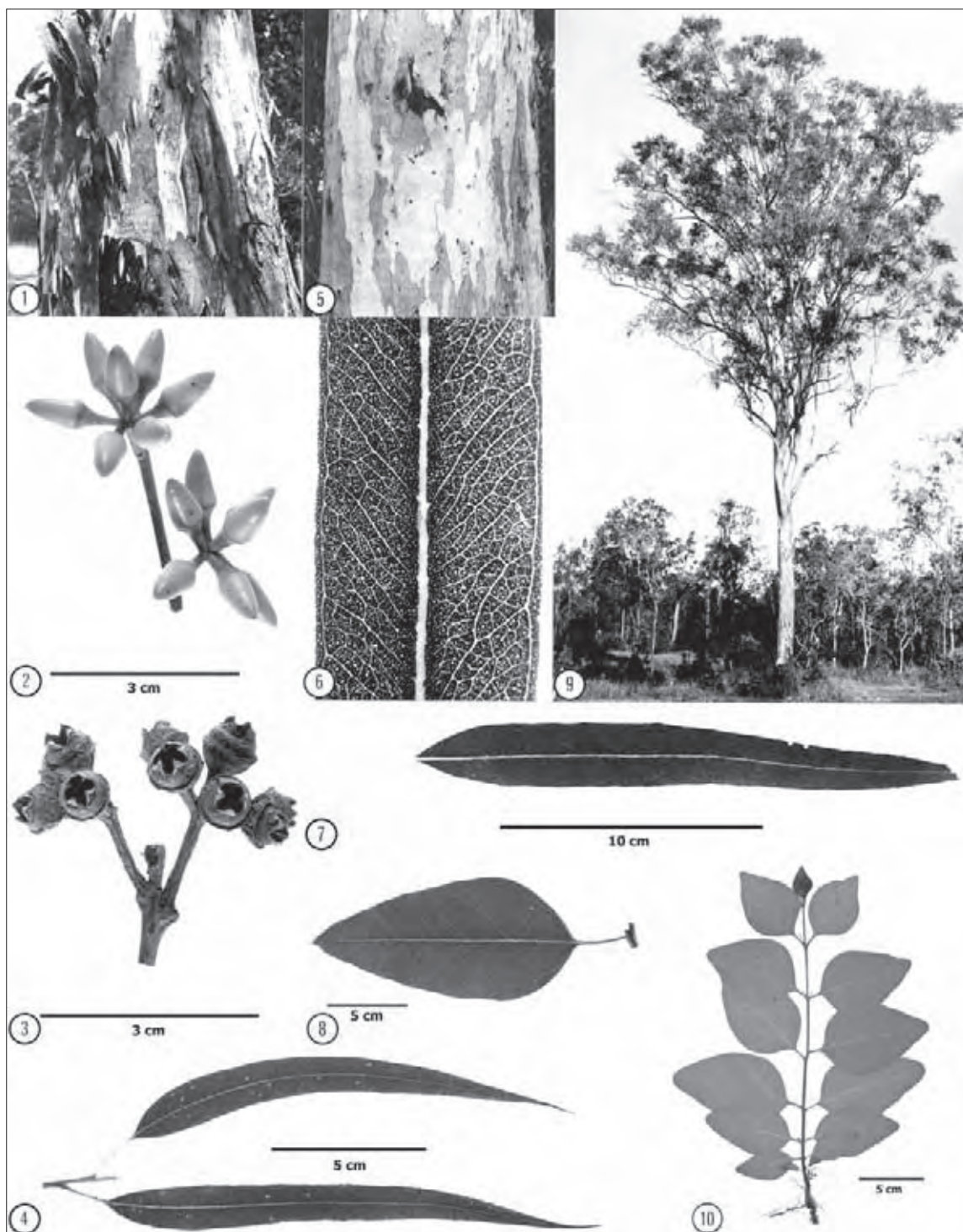
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles angular, 0.7–2.5 cm long; pedicels 0.3–1 cm long; buds 0.9–2 × 0.4–0.6 cm, hypanthia hemispherical; opercula elongated, horn-shaped, widening at the base, 2–7 times the length of the hypanthia (*tereticornis*), or shorter and obese (*mediana*). Flowers June–Nov. (*tereticornis*), Nov.–Jan. (*mediana*).

Fruits: Pedicellate, almost globular 0.3–0.6 (hypanthia only) × 0.4–0.8 cm; disc broad (often broader than hypanthia), steeply ascending; valves 4(5), strongly exserted. Seeds cuboid or elongated, black, pitted and toothed around edges (*tereticornis*) or mixed yellow and black (*mediana*), hilum terminal.

Wood: Sapwood pale, yellowish, susceptible to attack by *Lyctus* borers; heartwood red, with moderately fine texture and interlocked grain, hard, strong and durable; density 800–1100 kg m⁻³; used for heavy engineering construction, railway sleepers, piles, poles and posts and as flooring timber.

Climate: Altitudinal range: 10–1070 m (*tereticornis*), near sea level to 200 m (*mediana*); Hottest/coldest months: 23–35°C/1–17°C (*tereticornis*), 24–26°C/3–4°C (*mediana*); Frost incidence: low to moderate (*tereticornis*, *mediana*); Rainfall: 600–2500 mm per year, summer max. to uniform (*tereticornis*), 640–770 mm per year, uniform (*mediana*).

Distinctive features: A smooth-barked forest tree; seedling leaves broadly ovate; opercula elongated, conical or horn-shaped widening at the base, up to 7 times the hypanthia length; fruits with broad, steeply ascending disc and strongly exserted valves.



Eucalyptus tereticornis 1, 5. Bark 2. Buds 3. Fruits 4. Adult leaves 6. Adult leaf venation 7. Intermediate leaf 8. Juvenile leaf 9. Tree, between Mareeba and Mt Molloy, Qld 10. Seedling

Cabbage Gum

Eucalyptus amplifolia Naud.

Cabbage gum is a moderate-sized to tall tree; it is often somewhat bushy in habit and 12–20 m high, or a tree of good form to 30 m or more in height, with a straight bole which may be half the tree height. Like most open-grown red gums the trunk may divide below half tree height to form several large ascending stems, which form the framework of a broad, somewhat open crown. There are two subspecies, the typical and subsp. *sessiliflora*.

Subsp. *amplifolia* is a tree of eastern Australia, where it occurs mainly on the Central Coast and lower tablelands of New South Wales from Batemans Bay about 200 km south of Sydney to near Port Macquarie some 300 km to the north, but is absent from most of the north coast. Subsp. *sessiliflora* found on eastern parts of the Northern Tablelands of New South Wales and adjacent subcoastal forests with an extension to north of Stanthorpe in far south-eastern Queensland. Cabbage gum forms intergrade populations with forest red gum (*E. tereticornis*) where their distributions overlap.

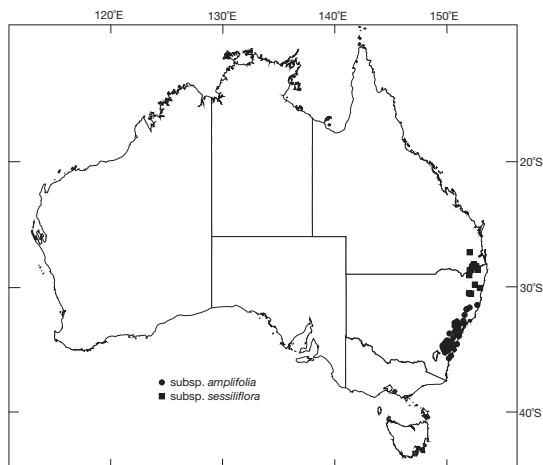
Throughout its area cabbage gum is mainly found on silty or clayey soils, often with poor drainage, in depressions or on the flats of rivers or streams. Soils are alluvial and derived from a wide range of parent materials that include granite, sandstone and basalt.

Cabbage gum usually grows in open or tall open forests. On the typical damp sites associated species may include forest red gum (*E. tereticornis*) and grey box (*E. moluccana*), but on the adjacent better-drained and usually poorer soils there may be a wide range of species, including grey gums, ironbarks and stringybarks. Associates of subsp. *sessiliflora* also include Dunn's white gum (*E. dunnii*), river oak (*Casuarina cunninghamiana*), and broad-leaved apple (*Angophora subvelutina*).

Related species: Cabbage gum belongs in series *Erythroxylon* with about 15 other species (Brooker 2000). It is easily distinguished from the many mallee species, e.g. *E. dwyeri*, but can be difficult to separate from two tree species with which it may overlap in distribution. One is *E. blakelyi*, which grows away from the coast and on the higher ground of the tablelands, and is a poorer formed tree, sometimes with pruinose buds and fruits. The other is *E. tereticornis* which has a much longer operculum, characteristically widened at its base. A key character for the distinction of cabbage gum is the much greener leaves at all stages, and the more prolonged horizontal leaf phase in the seedling and juvenile growth. Slaty red gum (*E. glaucina*), of restricted distribution in subcoastal ranges and hills from Taree to Broke, and near Casino, in New South Wales has dull leaves and broader, pruinose buds.

Publication: Subsp. *amplifolia*: Descr. *Emploi Eucalyptus intro. Europe* 28 (1891). Type: Several types cultivated in France, Algeria and Italy by C. Naudin. Subsp. *sessiliflora* (Blakely) L.A.S. Johnson & K.D. Hill: *Telopea* 4, 52 (1990). Type: Acacia Creek, Macpherson Range, Dec. 1904, W. Dunn 47.

Names: Botanical—Latin *amplus* (large) and *folium* (leaf) referring to the leaves at all growth stages and *sessilis* (sessile)



and *flora* (flower), of the buds and fruits. Common—‘cabbage gum’ is applied to a number of eucalypts which have very large juvenile or mature leaves.

Bark: Shed in irregular plates leaving the surface smooth with white, grey and bluish patches corresponding to pieces of bark being shed at different times, smooth bark weathering often to granular. Frequently some rough, dark grey to black dead bark is retained at the base of the tree.

Leaves: Seedling—the first 4–6 pairs opposite then alternate, initially sessile but soon petiolate, broadly ovate to orbicular, 7–11 × 5–8 cm, green, discolorous. Juvenile—alternate, petiolate, orbicular, 5–22 × 3.5–18 cm; glossy green, concolorous. Intermediate—alternate, petiolate, suborbicular to broadly ovate, slightly oblique base, 7.5–12.5 × 3.8–5 cm, glossy green, concolorous. Adult—alternate, petiolate, lanceolate, 10–25 × 1.5–7 cm, glossy green, concolorous.

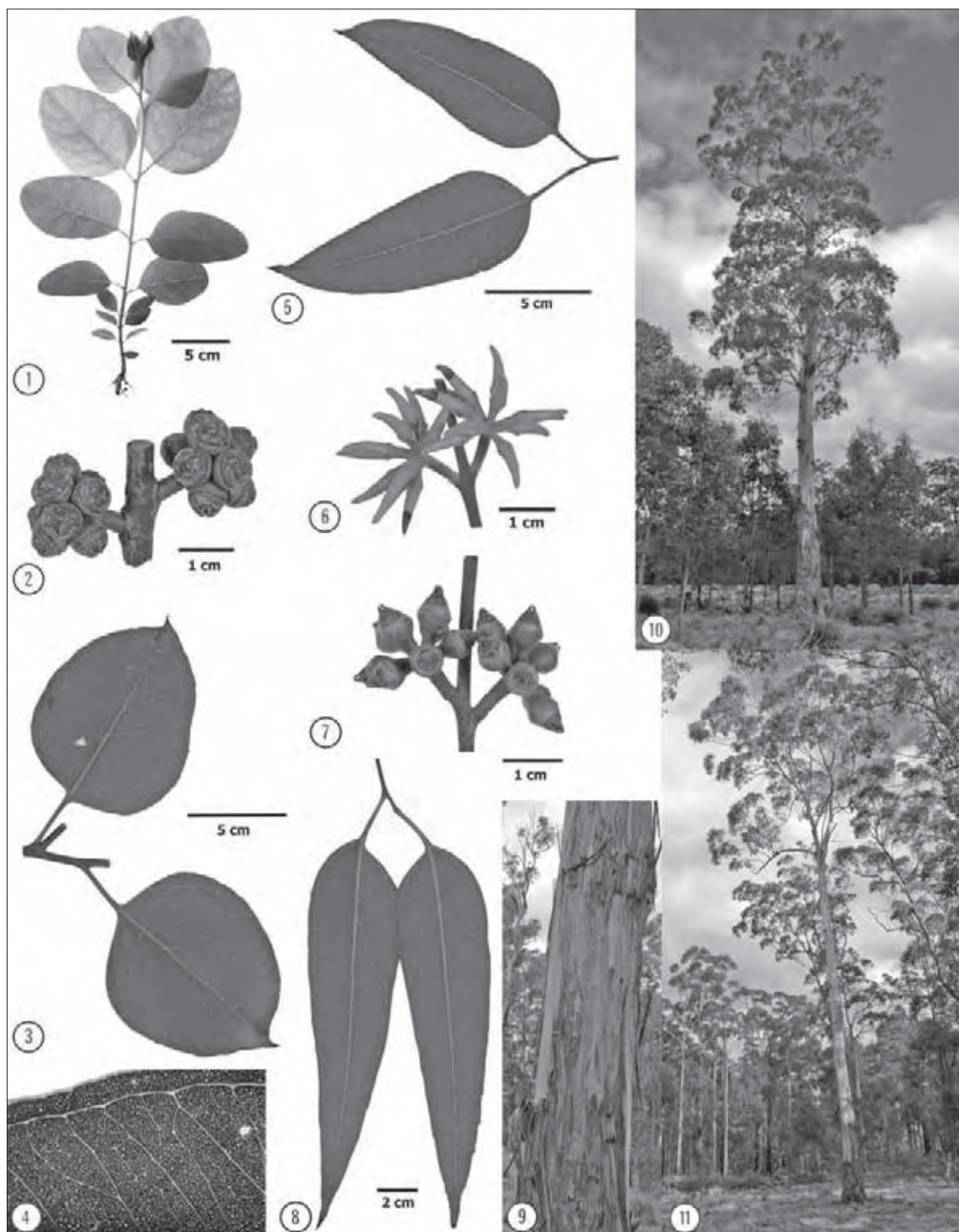
Inflorescences: Simple, axillary 7 to >11-flowered; peduncles compressed to slightly angular, 0.7–1.5 cm long, pedicels terete, somewhat slender up to 0.8 cm long (*amplifolia*) or sessile (*sessiliflora*); buds elongated, to 1.2 cm long; opercula conical or horn-shaped. Flowers Nov.–Jan.

Fruits: Pedicellate (*amplifolia*) or sessile (*sessiliflora*), almost globular (including the disc), 0.3–0.6 (hypanthia only) × 0.4–0.8 cm; disc broad, steeply ascending; valves 4(5), strongly exserted. Seeds cuboid or elongated, black, hilum terminal.

Wood: Heartwood reddish brown, straight to interlocked grain, moderate to fine-textured. The timber of this tree is regarded as inferior in hardness, strength and durability to many of the commercial species of the red gum group; density is 630–850 kg m⁻³ and lower than the main commercial red gum timbers; susceptible to attack by *Lyctus* borers.

Climate: Altitudinal range: near sea level to 920 m; Hottest/coldest months: 24–29°C/0–8°C; Frost incidence: low to high (inland at high elevations); Rainfall: 650–1450 mm per year, summer max. to uniform.

Distinctive features: A typical redgum with smooth bark; all leaves glossy green; juvenile leaves broad and held horizontally for more pairs than other red gums.



Eucalyptus amplifolia: subsp. *amplifolia* (a), subsp. *sessiliflora* (s) 1. Seedling 2. Fruits (s) 3. Juvenile leaves 4. Adult leaf venation 5. Intermediate leaves 6. Buds (a) 7. Fruits (a) 8. Adult leaves 9. Bark 10, 11. Trees, Styx River State Forest, N.S.W

Blakely's Red Gum

Eucalyptus blakelyi Maiden

Blakely's red gum is a medium-sized tree, usually 10–25 m tall and up to 1 m or more dbh. The trunk is mostly short and less than half the tree height. The crown is large, with the branchlets often drooping.

This species occurs largely in New South Wales where it is widespread on the western slopes and adjacent edges of the western plains in the north, and on the tablelands. It is one of the common trees on the plains around Canberra. The occurrence in Victoria is on the gentle slopes along the Hume Highway from the State border west to St Arnaud. In Queensland, it is known from near Stanthorpe near the Queensland–New South Wales border in Girraween National Park.

On the tablelands, Blakely's red gum is a species of the relative lowlands, but on the lower western slopes and plains its topographic preferences are more varied. Further north in drier areas and with higher summer temperatures it favours depressions where water only flows intermittently. It prefers more compact loams of moderately good quality, which do not dry out in summer, but will grow on poorer soils. In the Pilliga Scrub and elsewhere in the north-west it occurs on low sand ridges apparently representing old sanded-up watercourses.

Blakely's red gum is typically a woodland species but it is not uncommon to find small pure stands in open forests in damp depressions. Associated eucalypts may include yellow box (*E. melliodora*), red stringybark (*E. macrorhyncha*), scribbly gum (*E. rossii*), white box (*E. albens*), apple box (*E. bridgesiana*) and long-leaved box (*E. goniocalyx*), and also white cypress pine (*Callitris glaucophylla*).

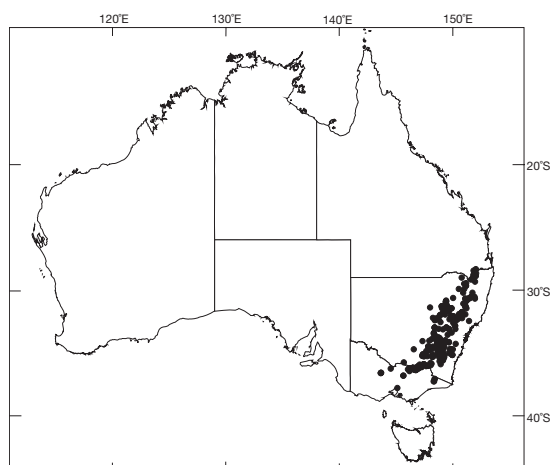
Related species: Blakely's red gum belongs in series *Erythroxylon* with about 15 other species (Brooker 2000). It is easily distinguished from the many mallee species (e.g. *E. dwyeri*) but can be difficult to separate from two tree species with which it may overlap in distribution, but it usually occupies colder, higher altitude regions. One is forest red gum (*E. tereticornis*), which has a more coastal distribution and is a more erect tree with steeply ascending branches, with longer opercula widening at the base, and is never pruinose. The other is cabbage gum (*E. amplifolia*), which has notably greener glossier leaves at all growth stages, and a more prolonged horizontal leaf phase in the seedlings and is never pruinose.

Publication: *Crit. Revis. Eucalyptus* 4, 43 (1920). Type: Pilliga Scrub towards Rocky Glen, New South Wales, 11 Aug. 1911, H.I. Jensen 129.

Names: Botanical and common both honour W.F. Blakely (1875–1941), a botanist with the New South Wales National Herbarium and author of *A Key to the Eucalypts* (1934).

Bark: Smooth throughout, shed in large irregular plates leaving white, grey, bluish, pink or yellowish patches; partly decorticated strips and plates may accumulate at the base, smooth bark weathering often to granular.

Leaves: Seedling—opposite for about 4 or 5 pairs then alternate, petiolate, elliptical to ovate or almost orbicular,



6–13 × 2.5–7 cm, greyish green, concolorous. Juvenile—alternate, petiolate, ovate to suborbicular, 7.5–14 × 4–10 cm, greyish green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 9–16 × 1–2 cm, green, concolorous.

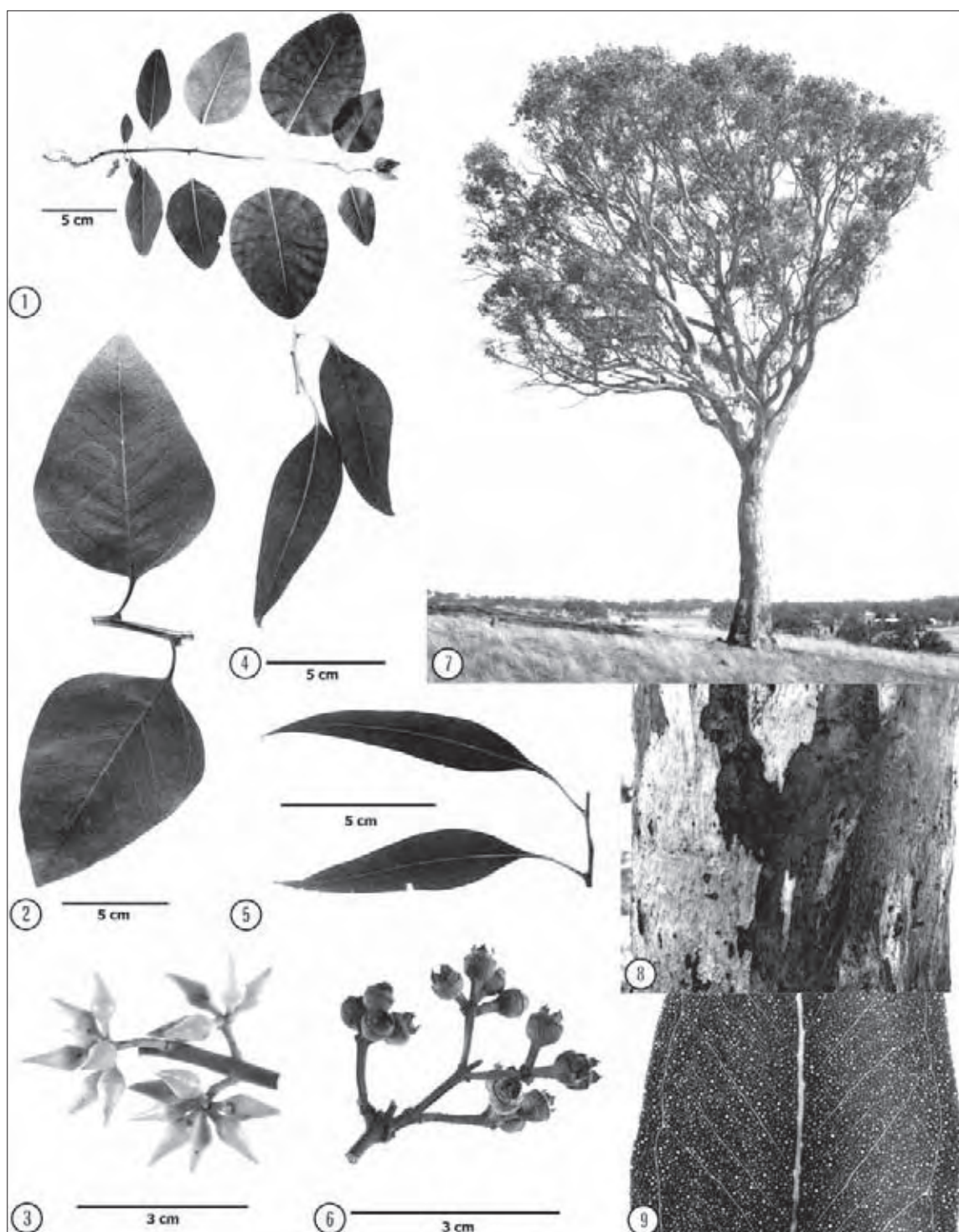
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles terete to angular, 0.7–1.9 cm long; pedicels 0.1–0.6 cm long; buds 0.9–1.4 × 0.3–0.6 cm, sometimes pruinose, hypanthia hemispherical to obconical; opercula conical to horn-shaped, 11/2–21/2 times the length of hypanthia. Flowers Nov.–Dec.

Fruits: Pedicellate, ovoid to globose (including the disc), 0.3–0.7 (hypanthia only) × 0.4–0.8 cm; disc moderately broad, ascending; valves usually 4, exserted. Seeds cuboid or elongated, black, hilum terminal.

Wood: Sapwood greyish to yellow-brown, susceptible to attack by *Lyctus* borers; heartwood pink to reddish brown, with uniform texture, interlocked grain, hard, strong, durable to very durable; density 840–980 kg m⁻³; used locally in the round or split for fencing or for firewood, potentially good joinery and flooring timber.

Climate: Altitudinal range: 150–1000 m; Hottest/coldest months: 26–32°C/0–4°C; Frost incidence: moderate to high; Rainfall: 600–950 mm per year, uniform to winter max. in the south.

Distinctive features: A typical red gum, a woodland tree, usually with a heavy bole; bark smooth, mottled, cream, grey, white, pink; opercula conical to horn-shaped; fruits with ascending discs and exserted valves.



Eucalyptus blakelyi 1. Seedling 2. Juvenile leaves 3. Buds 4. Intermediate leaves 5. Adult leaves 6. Fruits 7. Tree, west of Canberra, A.C.T. 8. Bark 9. Adult leaf venation

Moitch Flooded Gum, Colort, Swamp Gum, Wormwood, Blue Gum

Eucalyptus rudis Endl.

Moitch is usually a medium-sized tree 10–20 m tall with a dbh up to 1 m. The crown is wide spreading and the trunk short and usually of poor form. The crowns of adult trees over whole populations are often badly attacked by predatory insects and are notable for being partially defoliated for long periods. Taller, straighter trees, that do not appear to suffer defoliation by insects, occur on the mid to upper Blackwood River drainage system. There are two subspecies currently recognised, the typical and subsp. *cratyantha*.

This species occurs near the coast and in the nearby ranges from north of Geraldton to the south coast along major drainage systems. The typical subspecies occurs from around the lower Moore River region south to the Gordon River near Cranbrook and extends east to the Pallinup River north-east of Albany. The south-western form, subsp. *cratyantha* occurs from Mandurah south to Cape Naturaliste. A mainly smooth-barked form occurs north of Hill River but the delineation of the northern form is blurred due to intergradation with river red gum (*E. camaldulensis*).

This species occurs on river flats, along seasonal creeks and on swampy areas. Frequently it fringes the banks of permanent rivers, having a similar ecology as the related river red gum (*E. camaldulensis*), but unlike this species it more often extends upslope from river banks. It has a preference for the heavier silts and loams but will grow on clays and sands if there is sufficient ground water. There is usually clay at depth wherever it occurs and drainage may be poor.

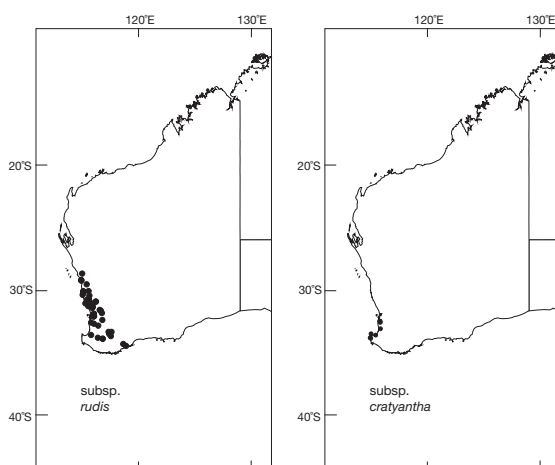
Moitch forms woodlands or open forests, usually in pure stands. Nearby eucalypts include wandoo (*E. wandoo*), marri (*E. calophylla*) and jarrah (*E. marginata*); other associated genera include *Melaleuca*, *Acacia* and *Hakea*.

Related species: Brooker (2000) placed this species in a series of its own on account of its dark brown or black, pitted, single-coated seeds when compared with the yellowish, smooth, double-coated seeds of series *Rostratae* (*E. camaldulensis*), and the black, single-coated seeds of series *Erythroxylon* (e.g. *E. tereticornis*) and *Phaeoxylon* (e.g. *E. exserta*). In the field, moitch should not be confused with any other species as it is mainly riparian and is the sole representative of section *Exsertaria* in the south-west of Western Australia. The fruit, which usually has a more or less level disc, is also unusual for a species from section *Exsertaria*.

Publication: In Endl., Fenzl., Benth. & Schott, *Enum. Pl. Hueg.* 49 (1837). Type: King George Sound, Western Australia, 1833, C. von Hugel, 1833.

Names: Botanical—Latin *rudis* (rough, crude, coarse), allusion obscure, possibly refers to the wood which was considered worthless; Greek *craty* (strong) and *anthos* (flower) refers to the larger flower. Common—of Aboriginal origin.

Bark: Typically a grey, box-type bark over the trunk and larger limbs, thin, shortly fibrous, with shallow longitudinal fissures, often tessellated; becoming thick and shaggy in old trees,



tending to be smooth, white-barked on the smaller branches. In some populations the bark is mostly smooth like river red gum, but the broader juvenile leaves among other characters distinguish it.

Leaves: Seedling—opposite for a few pairs then alternate, petiolate, ovate to almost orbicular, 4.5–8 × 3–5 cm, dull greyish green, slightly discolorous. Juvenile—alternate, petiolate, ovate to almost orbicular, 8–14 × 5–10.5 cm, dull greyish green, slightly discolorous at first then becoming concolorous. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 10–16 × 2.5–4.5 cm, green, concolorous. Adult—alternate, petiolate, broad-lanceolate to lanceolate, 9–14 × 1.5–3 cm, slightly glossy, green to grey-green, concolorous.

Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles terete to slightly angular, 0.6–1.5 cm long; pedicels 0.4–0.8 cm long; buds ovoid to diamond-shaped, 0.8–1.2 × 0.4–0.6 cm; opercula conical to slightly rostrate. Flowers Sept.–Nov.

Fruits: Pedicellate, more or less hemispherical, or campanulate, 0.4–0.6 × 0.6–0.9 cm; disc broad, more or less level, sometimes slightly ascending or descending; valves usually 4, exserted. Seeds cuboid to pyramidal, dorsal side finely pitted, some edges toothed, dark brown to black, hilum terminal.

Wood: Heartwood pale brown to reddish, heavy, hard, cross-grained, of low durability; density 550 kg m⁻³; mainly used for firewood.

Climate: Altitudinal range: near sea level to 380 m; Hottest/coldest months: 26–33°C/5–10°C; Frost incidence: low to moderate (up to 15 or more inland); Rainfall: 450–1100 mm per year, winter max.

Distinctive features: Typically a tree of river banks and flood-plains, usually with box-type bark; large buds and fruits for a red gum; leaves slightly glossy, green to grey-green; fruits usually with disc more or less level; old canopy often appears purplish after insect attacks.



Eucalyptus rudis 1. Buds 2. Fruits 3. Seedling 4, 7. Bark 5. Tree, near Northam, W.A. 6. Juvenile leaves 8. Intermediate leaf 9. Adult leaf venation 10. Adult leaves

Queensland Peppermint Yellow Messmate, Peppermint

Eucalyptus exserta F. Muell.

Queensland peppermint, on the better soils and in the higher rainfall areas of its distribution, attains 25 m or more in height, has a straight bole more than half the tree height and a dbh up to 1 m. In the drier inland part of the range, however, it is commonly 10–15 m in height, with a short bole of poor form.

Queensland peppermint is widespread in eastern Queensland south from inland of Cairns to just inside the far north of New South Wales near Yetman. It extends for a distance of about 1500 km along the east coast and from the coast inland for up to 800 km. It has its best development in the coastal belt from near Gladstone around latitude 24°S, southwards to the Maryborough and Gympie districts around latitude 26°S.

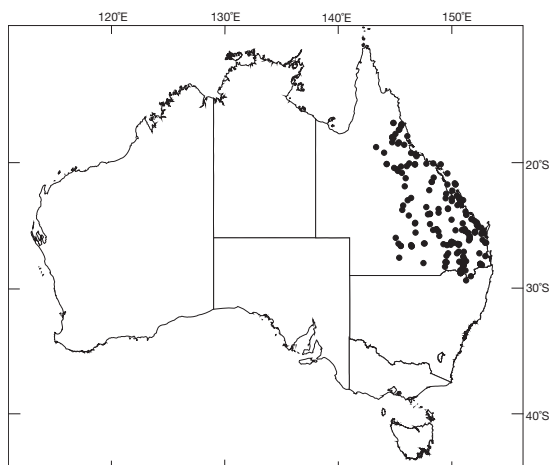
This species grows on a range of topography, which varies from coastal lowlands and hill slopes to the gentle undulating areas of the inland and the small but often steep hills and ridges, which occur there. In the drier areas it is often found on low stony rises. The soil types range from poor sands and skeletal soils to soils derived from volcanic material, while best development is on somewhat heavy loams of alluvial origin.

Queensland peppermint occurs mainly as scattered trees in open forests but it may attain local dominance on loamy or alluvial soils with better moisture conditions. Farther inland it occurs in woodlands or low woodlands. Associated species include brown bloodwood (*E. trachyphloia*), narrow-leaved red ironbark (*E. crebra*), spotted gum (*E. maculata*), grey box (*E. moluccana*), lemon-scented gum (*E. citriodora*), cypress pine (*Callitris glauco-phylla*), *Melaleuca* spp. and *Acacia* spp.

Related species: Queensland peppermint belongs in a small group of eastern red gums (series *Phaeoxylon*), which differ from the other eastern red gums in the persistent, usually hard, rough, outer bark and usually narrower juvenile leaves (Brooker 2000). Taxonomically and geographically it occupies a position between the shrubby grey mallee (*E. morrisii*) of northern-central New South Wales and the small tropical tree Cape York red gum (*E. brassiana*) of far northern Queensland. *E. morrisii* is mostly 3-flowered, and *E. brassiana* has much broader juvenile leaves. It is also closely related to the pruinose, broader-leaved tree, *E. lockyeri*, from near Ravenshoe. Some of the most westerly occurrences of Queensland peppermint, previously considered to represent a mallee form, were recognised as a new species, *E. ammophila* by Brooker and Slee (1994). It differs in having flakier rough bark, broader juvenile leaves and is restricted to red sands.

Publication: *J. Proc. Linn. Soc. Bot.* 3, 85 (1859). Type: Near the Burnett River, Queensland [west of Maryborough], F. von Mueller.

Names: Botanical—Latin *exsertus* (exserted), presumably of the valves. Common—refers to state of occurrence and to bark type (though not a peppermint as understood in southern Australia).



Bark: Rough and persistent on the trunk and larger branches, hard, with longitudinal fissures, decorticating from branchlets exposing grey, smooth bark.

Leaves: Seedling—opposite for up to 7 pairs then alternate, very shortly petiolate, narrow-lanceolate to linear, 4.5–13 × 0.6–1.2 cm, green, slightly discolorous. Juvenile—alternate, shortly petiolate, linear 11–19 × 0.3–0.9 cm, green, slightly discolorous. Intermediate—alternate, petiolate, narrow-lanceolate to broad-lanceolate, 11–19 × 1.5–2.7 cm, green, concolorous. Adult—alternate, petiolate, narrow-lanceolate, 8–18 × 0.7–1.7 cm, green, concolorous.

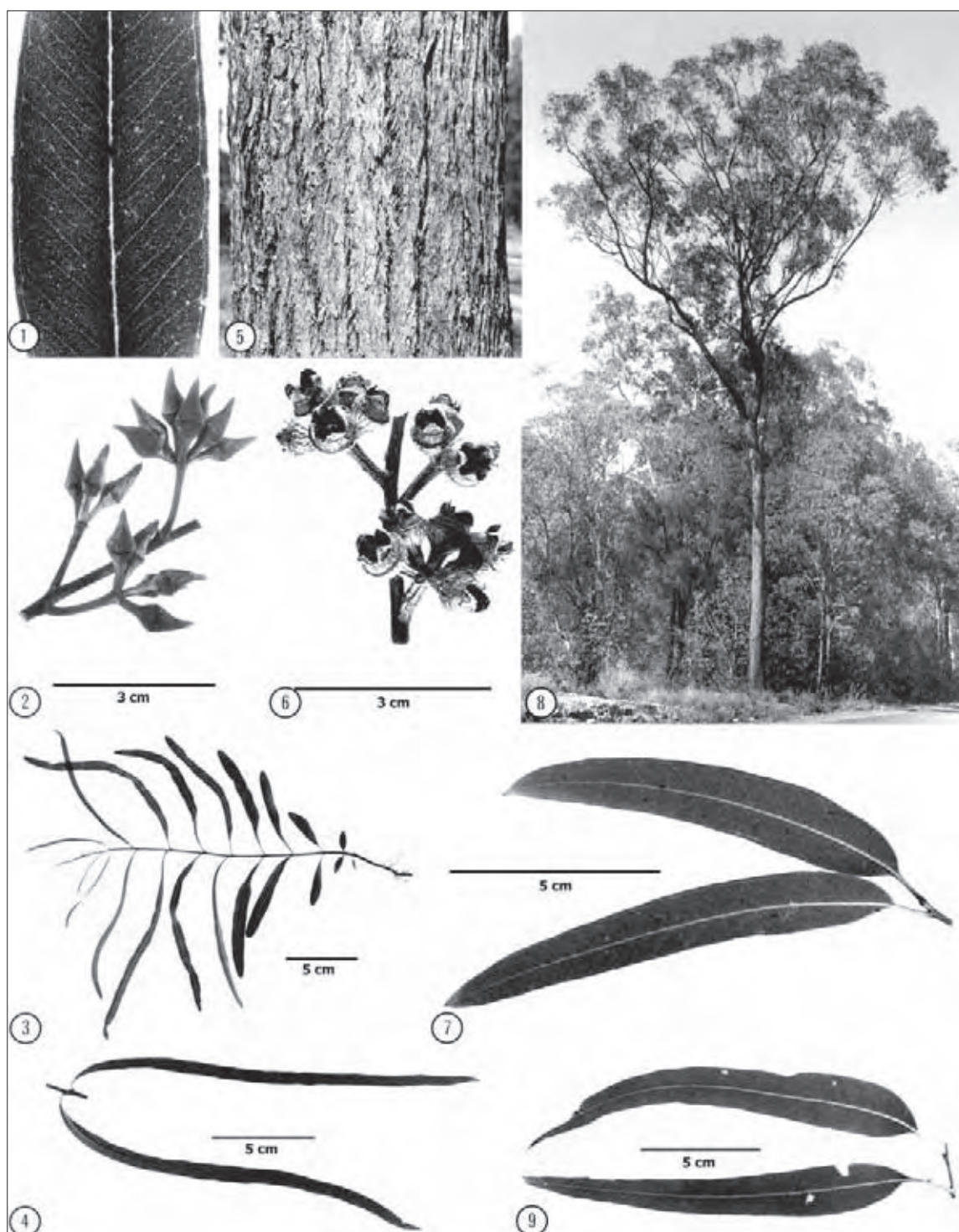
Inflorescences: Simple, axillary, 7-flowered; peduncles stout, more or less terete to angular, 0.4–2 cm long; pedicels occasionally absent, otherwise angular, 0.1–0.5 cm long; buds ovoid or diamond-shaped, 1–1.3 × 0.4–0.5 cm; opercula conical, usually longer than the hypanthia. Flowers Nov.–Feb.

Fruits: Pedicellate or occasionally sessile, ovoid or truncate-globose (including the disc) 0.3–0.8 (hypanthia only) × 0.4–0.9 cm; disc broad, steeply ascending; valves usually 4, broad, relatively short, strongly exserted. Seeds elongated or pyramidal, strongly toothed, black, hilum terminal.

Wood: Sapwood greyish to cream, heartwood pale pinkish brown, with fine and uniform texture, interlocked grain, heavy, hard, durable, somewhat brittle with kino (gum) veins; density 905–1010 kg m⁻³; used for general construction, particularly house framing, and in the round or split for farm fencing material and good firewood.

Climate: Altitudinal range: near sea level to 900 m; Hottest/coldest months: 28–36°C/2–16°C; Frost incidence: low to moderate (up to 20 inland); Rainfall: 400–1800 mm per year, summer max.

Distinctive features: A small to medium-sized tree with persistent, hard, rough bark on trunk and larger limbs, or a small, half-barked mallee in drier regions or rockier sites; fruits characteristic of the red gum group, with very broad ascending discs and strongly exserted valves; juvenile leaves linear, sometimes only 0.3 cm wide.



Eucalyptus exserta 1. Adult leaf venation 2. Buds 3. Seedling 4. Juvenile leaves 5. Bark 6. Fruits 7. Adult leaves 8. Tree, south of Eidsvold, Qld 9. Intermediate leaves

■ Mallees, Mallets and Marlocks

Eucalyptus section *Bisectae* (Maiden) Brooker

This section, formerly referred to as section *Bisectaria* (Pryor and Johnson 1971), is a group of about 190 species making it the largest section in *Symphyomyrtus* and in the genus. The species are almost wholly confined to temperate parts of the continent and are absent from Tasmania.

The centre of speciation for the group is in southern Western Australia where many of the series are endemic. Only one series is endemic in the east (*Squamosae*), and shiny-barked gum (*E. pachycalyx*) of this series is the only species of *Bisectae* in the far north, where it occurs southwest of Atherton and further south in Queensland and New South Wales. Several species including red mallee (*E. oleosa*), narrow-leaved red mallee (*E. leptophylla*) and yorrell (*E. gracilis*) are widespread from Western Australia, east to the drier, western parts of New South Wales. Series *Levispermae*, endemic to Western Australia, contains the largest number of species (about 26).

Most of the species are mallees, i.e. having multiple stems arising at ground level from a lignotuberos rootstock and rarely more than 5 m tall. Some are mallets (e.g. *E. ornata*), which are small arborescent trees, usually no more than 10 m tall, that have relatively long, well-developed trunks. They are characterised by being non-lignotuberos and regenerate prolifically from seed often to form dense pure stands. Another endemic Western Australian Aboriginal name for trees is marlock. Marlocks are similar to mallets in being small, non-lignotuberos trees, but differ in having a short trunk that branches early to form a crown-dominated habit (e.g. *E. conferruminata*). The tree species including wandoo (*E. wandoo*), powderbark wandoo (*E. accedens*), redwood (*E. transcontinentalis*) and salmon gum (*E. salmonophloia*) provide strong, durable timbers, which have been used extensively for mining poles, railway sleepers and fencing. Some species are notable for establishment in saline areas, e.g. swamp yate

(*E. occidentalis*) and Salt River gum (*E. sargentii*). The mallees are small and of little use other than providing valuable firewood, although there are some notable ornamentals including pear-fruited mallee (*E. pyriformis*), red-flowered mallee (*E. erythronema*), Bald Island marlock (*E. conferruminata*), caesia and Silver Princess (*E. caesia*), lemon-flowered mallee (*E. woodwardii*), mottlecah (*E. macrocarpa*) and Strickland's gum (*E. stricklandii*).

Botany

Section *Bisectae* is distinguished in *Symphyomyrtus* by the bifid cotyledons (see Fig. 16c on page 204). Bark characters are variable and are not diagnostic of series. Swamp yate (*E. occidentalis*) is fibrous-barked and salmon gum (*E. salmonophloia*) is famous for its beautiful, smooth, salmon-coloured bark. The mallees are generally smooth-barked although often with a basal stocking of rough bark.

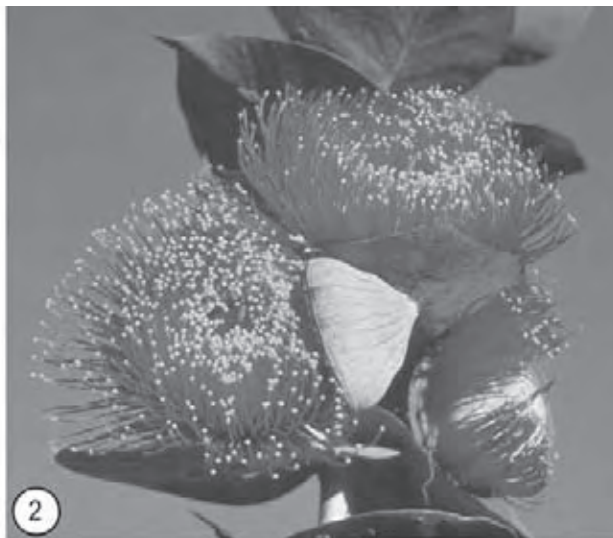
The section divides into subsection *Hadrote*s, species with coarsely bisected to bilobed cotyledons (e.g. *E. conferruminata*), and two subsections with deeply bifid cotyledons, *Glandulosae*, species with glands in the pith of the branchlets (e.g. *E. eremophila* and *E. salubris*), and *Destitutae*, species lacking pith glands (e.g. *E. oleosa* and *E. macrocarpa*). *E. decurva* and *E. doratoxylon* are somewhat divergent with pale green, wide-angled bisected cotyledons.

Two groups, *Hadrote*s and series *Erectae* are notable for the large buds with long horn-shaped opercula but otherwise, operculum shape is very variable in the section, from horn-shaped in some *Levispermae* (e.g. *E. wandoo*) to hemispherical in *E. loxophleba*. The anthers vary from oblong, versatile, opening by longitudinal slits, e.g. series *Contortae* (*E. salubris*), to orbicular, opening by large lateral pores, e.g. series *Subulatae* (e.g. *E. transcontinentalis*), to globular, adnate, opening by terminal pores, as in series *Porantherae* (e.g. *E. foecunda*).

Fruit shape and size are often consistent within series and in the *Subulatae*, the fruits are characteristic because the split style is persistent for a while and remains prominently exerted

and attached to the valve tips. Some species of series *Curviptera* have the largest fruits in the genus, e.g. *E. youngiana*. Seed characters are extremely variable but the flattened-ovoid, grey brown, relatively unsculptured seed form (except

for some shallow longitudinal furrowing) is common. Exceptions include the almost spherical seed in some species of series *Levispermae* (e.g. *E. gardneri*) and the honeycombed seed of series *Contortae* (e.g. *E. salubris*).



Species in sections *Bisectae* and *Dumaria* are notable for the morphological diversity of their buds and fruits. 1. *Eucalyptus caesia*. 2. *E. macrocarpa*. 3. *E. talyuberlup*. 4. *E. tetraptera*.

Yate

Eucalyptus cornuta Labill.

On favourable sites, particularly in the west of its range, yate is a tree of good form up to 25 m in height with dbh up to 1 m. It forms a moderately heavily branched crown carrying fairly dense foliage. Few tall trees remain, however, due to extensive logging and clearing for urban development. On coastal sites, and particularly in the east of its range, yate develops a mallee habit.

Yate is endemic to southern Western Australia. In the west of its distribution it occurs in the same general areas as karri (*E. diversicolor*) in a belt mainly less than 80 km wide, which stretches along the south coast from the Busselton area to slightly east of Albany, a distance of about 300 km. Farther east it is more strictly a coastal species and occurs as far as the islands of the Recherche Archipelago and to Rossiter Bay, east of Esperance.

This species is commonly found in fertile, moist valleys, but near the coast in the Albany region it extends on to the hillsides when the soil is suitable. Soils include gravelly loams, which are at least moderately fertile, and poorer coastal sands. There are numerous parent rock types ranging from granite to limestone. The subsoil is usually somewhat moist but not waterlogged.

Yate usually occurs in open forests as scattered trees associated in the western part of its distribution with tuart (*E. gomphocephala*) and jarrah (*E. marginata*) in the Busselton area, or with moitch (*E. rudis*) in swampy areas towards Albany. Farther east it occurs with coastal species such as Mt Le Grand mallee (*E. aquilina*) at Thistle Cove and Bald Island marlock (*E. conferruminata*) on the islands of the Recherche Archipelago. It may, at times, form small, pure stands in dense coastal closed shrublands.

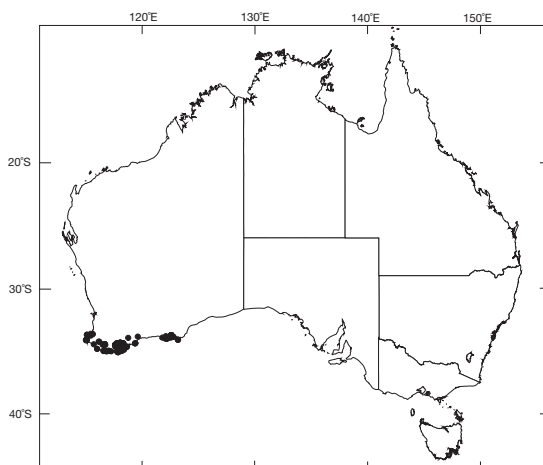
Related species: Brooker (2000) placed yate with river yate (*E. macrandra*) in subsection *Hadrotres*, characterised by the large buds and fruits, glabrous seedlings and olive-green leaves that have a glazed surface. The hypanthia are not fused, distinguishing the two species from the other *Hadrotres* species (e.g. *E. conferruminata*). Yate is distinguished by the long opercula and by the fruit, which have a domed disc coherent across the fruit orifice and covering most of the valves.

Publication: *Voy. Rech. Perouse* 1, 403 (1799). Type: Observatory Island, Western Australia, 17 Dec. 1792, J. de Labillardière.

Names: Botanical—Latin *cornutus* (horned), of the opercula. Common—of Aboriginal origin.

Bark: Rough and persistent on the trunk and larger branches, moderately thick, dark grey or almost black, hard, deeply furrowed; shed from the upper branches in long ribbons, leaving a smooth grey or grey-brown surface.

Leaves: Seedling—opposite for about 3 or 4 pairs then alternate, petiolate, orbicular to ovate, 2.7–5 × 2–5 cm, green, discolorous. Juvenile—alternate, petiolate, orbicular to ovate, 5–7 × 5–7 cm, green, discolorous. Leaf edges in seedling and juvenile stages are often somewhat crenulate and undulate.



Adult—alternate, petiolate, elliptical, 8–14 × 1–3.5 cm, glossy green to grey-green, concolourous.

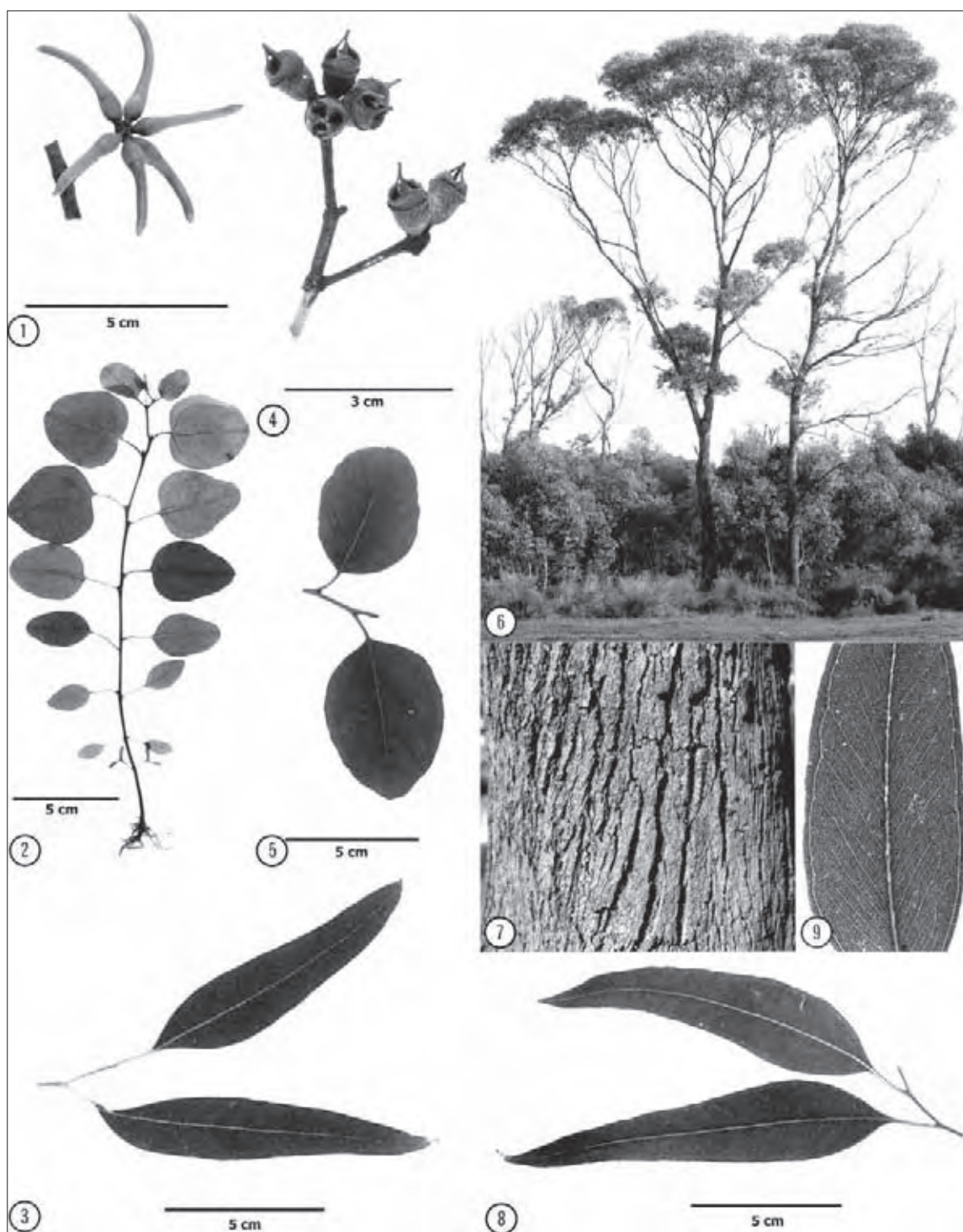
Inflorescences: Simple, axillary, many-flowered (generally more than 11); peduncles broad, stout, angular or flattened, 1.7–3 cm long; pedicels absent or occasionally very short; buds 2–4.2 × 0.4–0.8 cm, hypanthia more or less hemispherical, usually faintly ribbed; opercula horn-shaped, 3–6 times the length of the hypanthia. Flowers Jan.–Feb.

Fruits: Sessile to very shortly pedicellate, hemispherical, cylindrical or campanulate, crowded, hence often distorted by compression, 0.7–1.4 × 0.6–1.3 cm; disc domed, embracing the base of the valves; valves generally 3, broadly based, prominently exserted and usually joined at the tips. Seeds flattish to ovoid, black, hilum ventral.

Wood: Heartwood pale grey to yellow-brown, very heavy, grain interlocked, durable, one of the hardest and strongest timbers in the world; density 990–1130 kg m⁻³; used formerly for wheelwright work but now of very limited availability.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 24–29°C/6–11°C; Frost incidence: low; Rainfall: 700–1200 mm per year, winter max.

Distinctive features: A rough-barked tree, less often a shrub; pith of branchlets glandular; inflorescences with many buds; opercula very long, horn-shaped; fruits with prominent valves remaining coherent at tips.



Eucalyptus cornuta 1. Buds 2. Seedling 3. Adult leaves 4. Fruits 5. Juvenile leaves 6. Trees, near Albany, W.A. 7. Bark 8. Intermediate leaves 9. Adult leaf venation

Bald Island Marlock

Eucalyptus conferruminata D.J. Carr & S.G.M. Carr

Bald Island marlock typically branches low to form a bushy tree to 8 m tall or sometimes taller to 12 m. In more exposed coastal sites it may be reduced to shrub height. The canopy is dense and leaves are held at an acute angle to the stem giving the crown a distinctive uniform appearance. Branching is usually spreading.

This is a coastal species endemic to Western Australia. It extends east from Bald Head south of Albany, sporadically along the coast to islands in the Recherche Archipelago, east of Esperance. It is rarely found far from granite topography common along this stretch of coast.

Bald Island marlock forms colonies in the saddles, crevices and at the base of granite rock outcrops. Soils are typically shallow sandy loams.

It occurs in low woodlands or tall shrublands often in pure stands. When present, associated eucalypts include tallerack (*E. pleurocarpa*), bell-fruited mallee (*E. preissiana*), Cape Le Grande mallee (*E. aquilina*) or spearwood (*E. doratoxylon*).

Related species: Brooker (2000) placed Bald Island marlock in subsection *Hadrotes*, series *Lehmannianae*, subseries *Conjunctae*, a small group of species that have fused hypanthia, exceptionally long opercula with erect stamens and large fruits with fused valve tips. Its three closest relatives, *E. lehmannii*, *E. mcquoidii* and *E. arborella*, have much longer and more slender opercula. The species with a similar habit, *E. mcquoidii*, is further distinguished by its terete peduncles, its 21–50 buds per unit inflorescence and is restricted to the Quoin Head area in Fitzgerald River National Park.

Publication: *Austral. J. Bot.* 28, 535 (1980). Type: Middle Mt Barren, Western Australia, 16 Jul. 1970, A.S. George 10097.

Names: Botanical—Latin *conferruminatus* (fused), refers to the fused buds and fruits. Common—refers to the island to the east of Albany near where the species was first discovered and to its habit.

Bark: Smooth to ground level, mottled grey-white to silver-grey.

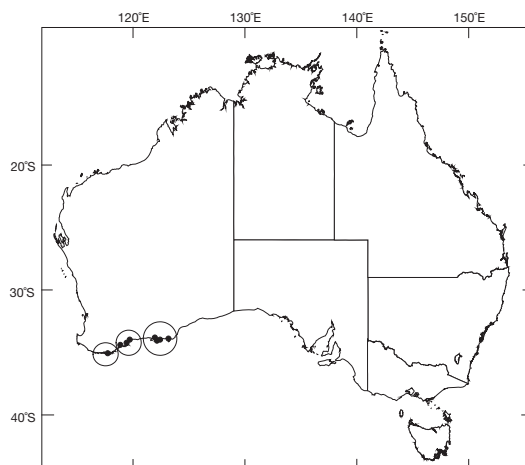
Leaves: Seedling—opposite for about 3–7 pairs then alternate, petiolate, orbicular to ovate, 3–8 × 2–7 cm, scabrid, pale green, concolorous. Juvenile—alternate, petiolate, orbicular to ovate, to 10 × 4 cm, green, concolorous. Adult—alternate, petiolate, petioles to 1.2 cm long, elliptical, 4–9 × 1–3 cm, slightly glossy, green, concolorous.

Inflorescences: Simple, axillary, 15 to 21-flowered or sometimes more; peduncles flattened, broad, 2–3 cm long; pedicels absent; buds sessile, hypanthia fused, with upper part free, opercula stoutly horn-shaped, 3–6 cm long, hypanthia fused; filaments yellow-green. Flowers Aug.–Nov.

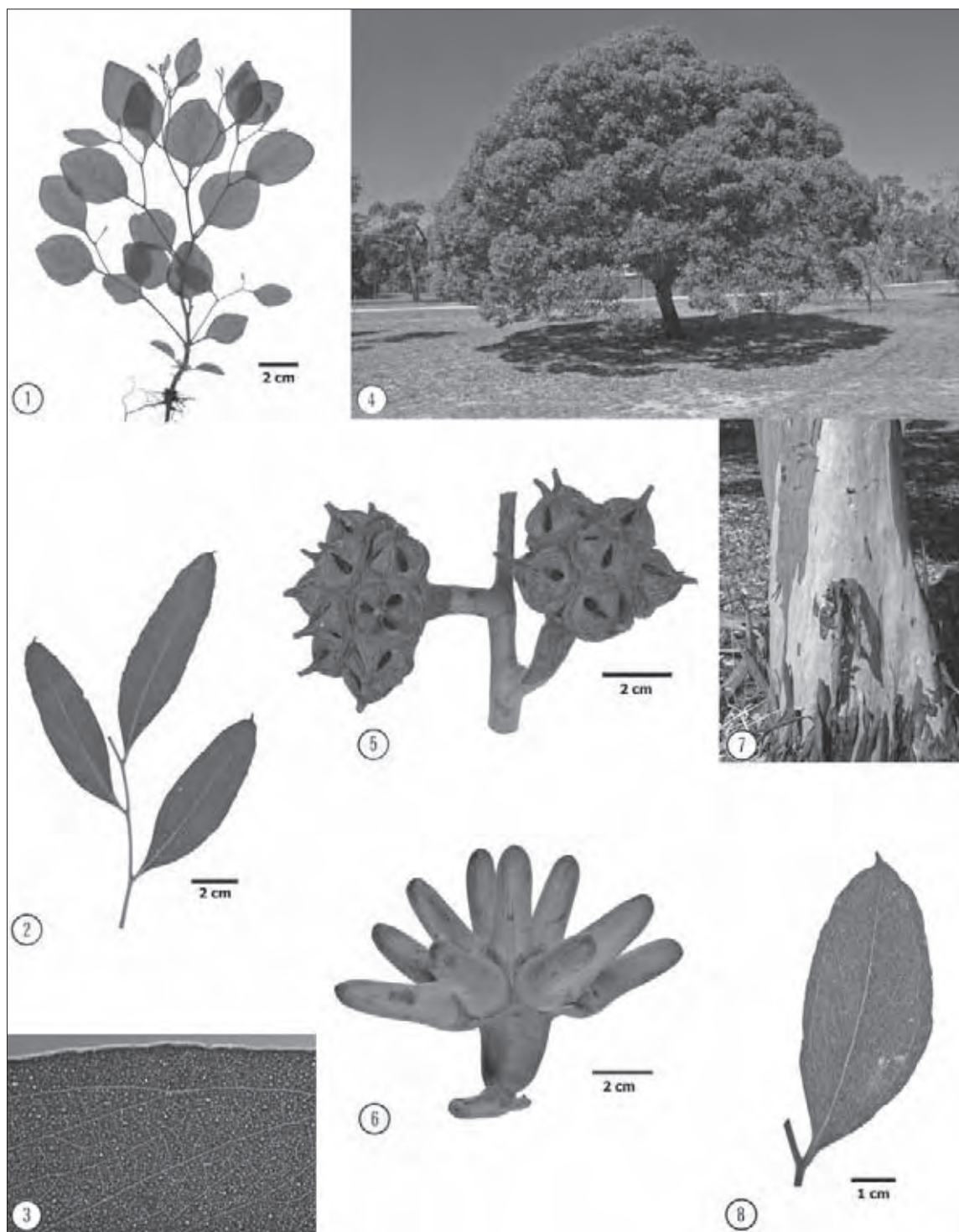
Fruits: Sessile, fused, 4–6 × 6–8 cm; rim thick; disc broad, lobed, ascending; valves 3, exerted, fused at tips. Seeds irregular to ovoid, black, hilum ventral to terminal.

Wood: Hard, pale brown to yellow-brown, density around 1000 kg m⁻³.

Climate: Altitudinal range: near sea level to 100 m; Hottest/coldest months: 26–27°C/6–7°C; Frost incidence: low; Rainfall: 450–700 mm per year, winter max.



Distinctive features: A non-lignotuberous shrub or mallet with smooth bark and large densely foliated crown; buds sessile, 15 to 21-flowered, with long ‘finger-like’ opercula and conspicuous yellow-green filaments when in flower; fruits fused to form a large spherical mass with valves strongly exerted and fused at tips. This species has become a popular amenity plant in parts of southern Australia. Also planted in near-coastal areas as a shelterbelt for stock.



Eucalyptus conferruminata 1. Seedling, 2. Adult leaves 3. Adult leaf venation 4. Tree, cultivated Floreat, Perth, W.A. 5. Fruits 6. Buds 7. Bark 8. Coppice leaf

Swamp Yate Flat-topped Yate

Eucalyptus occidentalis Endl.

Swamp yate is a tree 10–20 m tall with a dbh up to 0.5 m, or in poor situations, e.g. coastal swamps, it may be reduced to a mallee. In the tree form the trunk is usually short and branches fairly low to form several stout primary branches. The canopy is predominantly terminal and moderately dense.

Swamp yate is distributed widely in the southern part of Western Australia including the Stirling Ranges. It is mostly found within 150 km of the south coast. This distribution does not include the far south-west but includes the southern wheat belt and continues east towards Israelite Bay.

The main occurrence of swamp yate is on low depositional terrain, usually alluvial flats subject to flooding, where the soil is often clayey. It can thrive near salt lakes and some provenances are notably salt-tolerant. Large stands may also be found away from depressions on low hills (e.g. east of Jerramungup) or at the base of granite rock outcrops (e.g. Pallerup Rock) on light brown, gravelly sandy loams.

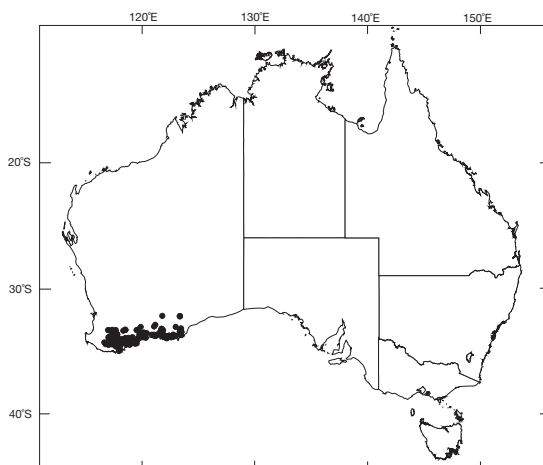
Swamp yate occurs mainly in woodlands often in pure stands. When present, associated eucalypts include York gum (*E. loxophleba*), open-fruited mallee (*E. annulata*), silver mallee (*E. falcata*), tallerack (*E. pleurocarpa*) or limestone marlock (*E. decipiens*).

Related species: Swamp yate was placed by Brooker (2000) in subsection *Glandulosae*, series *Erectae*, distinguished by the glandular pith of the branchlets and the erect stamens in the bud. This series divides into three subseries, *Abundae*, recognised by the obscure leaf venation and great density of oil glands and the broad persistent staminal ring obscuring the disc, subser. *Pedicellateae* (which includes swamp yate) and which has distinct leaf venation and fewer oil glands and an annular disc, and subser. *Annulatae*, a small group with crowded oil glands in the leaves and honeycombed seedcoats. Swamp yate may be confused with brown mallet (*E. astringens*), which has similar fruits but differs in being a non-lignotuberous mallet and occurs on lateritic breakaways. A related mallee of drier country east and north of the main distribution of yate was attributed to this species but has been distinguished as a distinct species, *E. aspratilis*. It has more or less cupular to cylindrical fruits compared to the campanulate fruits of yate and brown mallet.

Publication: *Enum. Pl. Huegel* 49 (1837). Type: 'Fremantle, Swan River', Western Australia (an error as it does not occur there), J. Huegel.

Names: Botanical—Latin *occidentalis* (western), of its distribution. Common—refers to the species preference for damp sites and 'yate' is of Aboriginal origin.

Bark: Rough, flaky and moderately thick for about half or most of the trunk, occasionally extending to the smaller branches, dark grey or black, longitudinally furrowed, coming off in irregular, untidy strips at the junction with the smooth bark which is grey-white and contrasts strongly with the basal bark; reputed to have a high tannin content.



Leaves: Seedling—opposite for about 4 pairs then alternate, petiolate, ovate, 4–6 × 2.4–3 cm, greyish green, discolorous. Juvenile—alternate, petiolate, ovate, 6–14 × 3–7 cm, dull, bluish green, discolorous. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 9–16 × 2.5–4.5 cm, green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 6–16 × 1–3.3 cm, glossy green, concolorous.

Inflorescences: Simple, axillary, 7-flowered; peduncles flattened, often recurved, 1–4 cm long; pedicels 0.3–1 cm long; buds 1.6–3.3 × 0.5–0.7 cm, hypanthia pyriform to campanulate; opercula elongated, horn-shaped, with a pointed or rounded tip, contracted just above the base, 1½–2 times as long as the hypanthia. Flowers Apr.–Aug.

Fruits: Pedicellate, campanulate, usually with faint striations, 0.8–1.5 × 0.6–1.2 cm, disc annular; valves usually 4, exserted, stout and broad, often outward-curved. Seeds flattish-ovoid, brown, hilum ventral.

Wood: Heartwood pale tan, hard, somewhat straight-grained, durable in damp soils but not so strong or durable as yate (*E. cornuta*), density 1000 kg m⁻³; 6-year-old trees cultivated in Victoria had a basic density of 570–595 kg m⁻³ and exhibited good potential for pulp paper production.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 26–31°C/4–7°C; Frost incidence: low to moderate (up to 20 each year at inland sites); Rainfall: 300–800 mm per year, winter max.

Distinctive features: A small tree usually of freshwater depressions with a thick, dark stocking of flaking, rough bark becoming firmer above, branches smooth, white or grey; pith of branchlets glandular; adult leaves green, glossy; peduncles long, stout, usually down-turned; buds with broad horn-shaped opercula up to 3 times the length of the base; fruits campanulate with annular disc and exserted valves.



Eucalyptus occidentalis 1. Adult leaf venation 2. Buds 3. Juvenile leaves 4, 5. Bark 6. Fruits 7. Tree, near Albany, W.A. 8. Seedling 9. Adult leaf

Brown Mallet

Eucalyptus astringens (Maiden) Maiden

Brown mallet is a small to medium-sized tree, 10–25 m in height and up to 0.7 m in diameter. The trunk is generally straight and may attain half or more of the tree height. The tree branches steeply while the crown is predominantly terminal and carries moderately dense foliage. There are two subspecies, the typical and subsp. *redacta*, which is a much smaller mallet than the typical subspecies.

Typical brown mallet grows in the wheat belt of Western Australia on the drier, inland side of the jarrah (*E. marginata*) belt. It occurs from west of Brookton, southward to Mt Barker and eastward to near Kondinin, Lake Grace and Hopetoun. The smaller brown mallet, subsp. *redacta* occurs between Albany and Bremer Bay and inland to Corackerup Nature Reserve and Lake Magenta.

Subspecies *astringens* occurs on country of low relief but always occurs on lateritic breakaways. Soils are sandy or clay loams exposed by the weathering away of the lateritic capping. In cultivation, however, it is adaptable to a wide range of soils. Subsp. *redacta* occurs on low sandy rises or near sedimentary, granitic or lateritic rocks.

Brown mallet forms woodlands or open forests, mainly in pure stands, but at times associated with other eucalypts such as powderbark wandoo (*E. accedens*), wandoo (*E. wandoo*) or York gum (*E. loxophleba*).

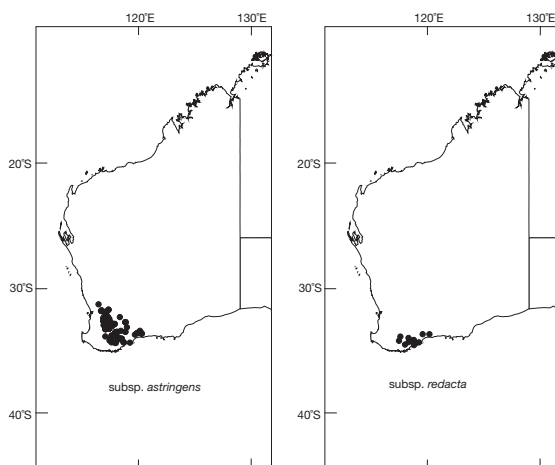
Related species: Brown mallet was placed by Brooker (2000) in subsection *Glandulosa*, series *Erectae*, distinguished by the glandular pith of the branchlets and the erect stamens in the bud. This series divides into three subseries, *Abundae*, recognised by the obscure leaf venation and great density of oil glands and the broad persistent staminal ring obscuring the disc, *Pedicellatae* which includes brown mallet and which has distinct leaf venation and fewer oil glands and an annular disc, and *Annulatae*, a small group with crowded oil glands in the leaves and honeycombed seedcoats. Brown mallet may be confused with swamp yate, *E. occidentalis*, which has similar fruits but differs in being a lignotuberous tree with rough bark compared to the non-lignotuberous brown mallet, which has smooth bark to ground level.

Publication: Subsp. *astringens*: *Crit. Revis. Eucalyptus* 7, 55 (1924). Type: Broomehill, Western Australia, Dec. 1909, J.H. Maiden. Subsp. *redacta*: *Nuytsia* 14, 353 (2002). Type: Wellstead Road to Cape Riche at the Mt Maxwell (Konkoberup Hill) rubbish tip, A.V. Slee 4117.

Names: Botanical—Latin *astringens* (binding, constrictive), refers to the bark which has astringent properties; Latin *redactus* (reduced) refers to the small buds and fruits compared to the typical subspecies. Common—mallet is derived from an Aboriginal term meaning a type of non-lignotuberous eucalypt that comes up in thickets and produces a dome-shaped canopy, while the colour refers to the wood.

Bark: Basically smooth throughout, with small curled flakes of older bark in patches, mainly near the base, brown and grey or slightly copper-coloured; tannin content high (40 per cent or more).

Leaves: Seedling—opposite for about 3 pairs then alternate, petiolate, ovate 4–6 × 2–4.3 cm, green or greyish green, concolorous. Juvenile—alternate, petiolate, ovate,



7–10 × 4–6 cm, green or greyish green, concolorous. Intermediate—alternate, petiolate, broad-lanceolate, 11–14 × 2–3.5 cm, glossy green, concolorous. Adult—alternate, petiolate, lanceolate, 7–11 × 0.8–2.3 cm, glossy green, concolorous.

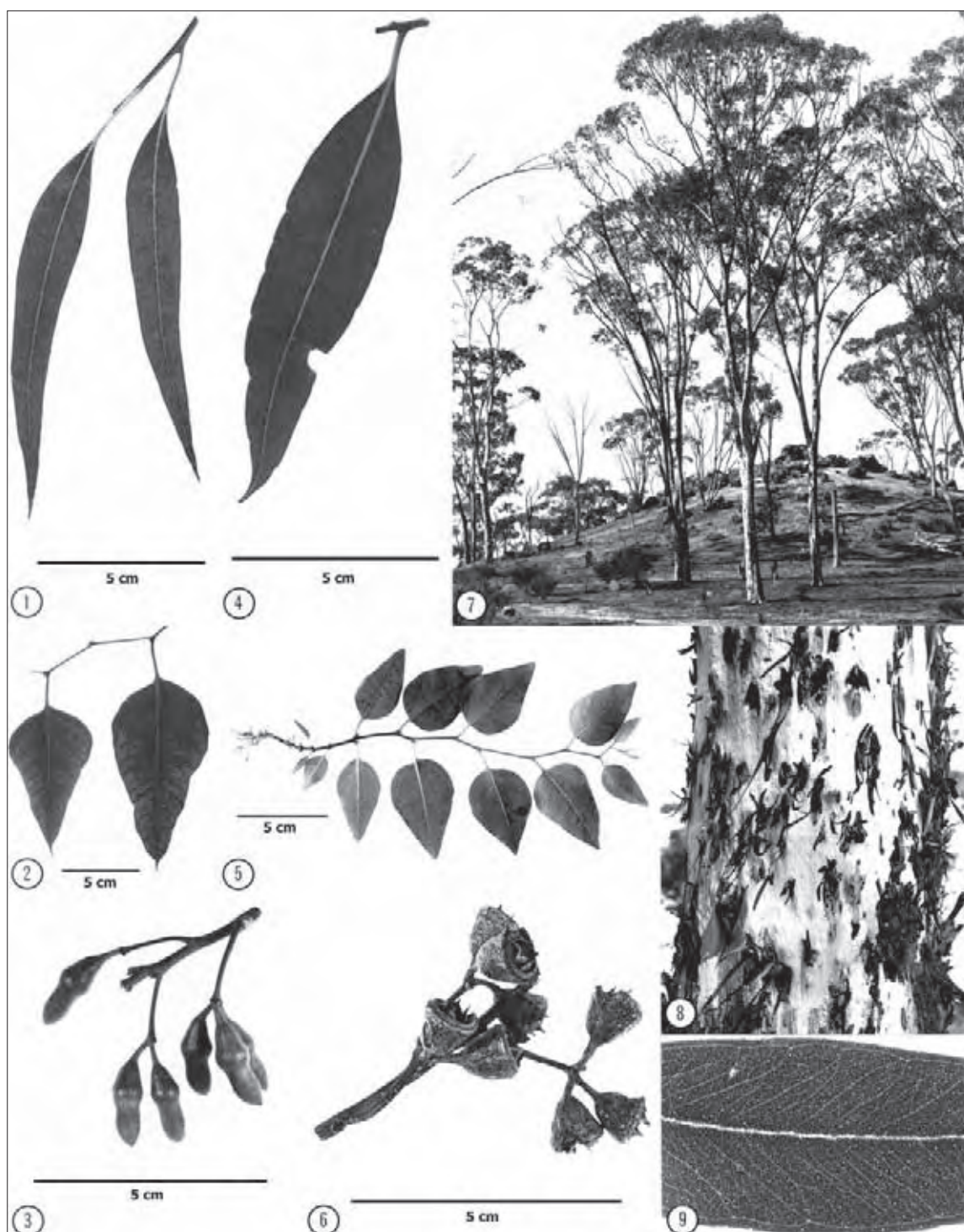
Inflorescences: Simple, axillary, 7-flowered; peduncles flattened, often down-curved, 1.1–3.4 cm long; pedicels 0.2–0.8 cm long; buds 1–2 × 0.4–0.6 cm (*astringens*), or to 1.5 × 0.4 cm (*redacta*); hypanthia cylindrical or campanulate; opercula horn-shaped, constricted in the centre, rounded or bluntly pointed, 1½–2 times the length of the base. Flowers Oct.–Nov.

Fruits: Pedicellate, campanulate or cylindrical, faintly striated, 0.8–1.2 × 0.7–1 cm (*astringens*), or to 0.9 × 0.7 cm (*redacta*); disc annular; valves generally 4, exserted and often outward-curved. Seeds flattish-ovoid, brown, hilum ventral.

Wood: Heartwood light red-brown to dark grey-brown, with reddish streaks darkening on exposure, fine texture and straight or interlocked grain, very hard, strong and very tough, moderately durable; density is in the range 870–1025 kg m⁻³; not susceptible to *Lyctus* attack, used for tool handles, mining timber, farm purposes and fuel.

Climate: Altitudinal range: 200–350 m; Hottest/coldest months: 27–34°C/4–6°C; Frost incidence: low to moderate (about 1–20 each year); Rainfall: 350–750 mm per year, winter max.

Distinctive features: Non-lignotuberous mallets forming colonies on lateritic breakaways, with bark shed to ground level often with small, scattered curling patches persisting; pith of branchlets glandular; inflorescences 7-flowered; opercula horn-shaped, up to double the length of the base; fruits campanulate, with exserted valves.



Eucalyptus astringens 1. Adult leaves 2. Juvenile leaves 3. Buds 4. Intermediate leaf 5. Seedling 6. Fruits
 7. Stand, near Pingelly, W.A. 8. Bark 9. Adult leaf venation

Salt River Gum Sargent's Mallet, Salt River Mallet or Mallee

Eucalyptus sargentii Maiden

Salt River gum comprises non-lignotuberous mallets (subsp. *sargentii*) up to 12 m tall with dbh to 0.6 m or small, lignotuberous mallees (subsp. *onesia*) up to 6 m tall. The trunk of the mallet is usually short and branches fairly low giving fairly steeply ascending primary branches. The mallee has a denser and more spreading habit. The canopy is moderately dense and terminal, subtended by a mass of slender intermediate branches.

Typical Salt River gum has a scattered distribution in western parts of the wheat belt of Western Australia, from Pithara in the north, south to east of Newdegate. Subsp. *onesia* occurs south from Piawaning to between York and Cunderdin. These taxa were probably much more abundant in the past and their survival in agricultural land has been largely due to their tolerance of saline sites that have been left uncleared.

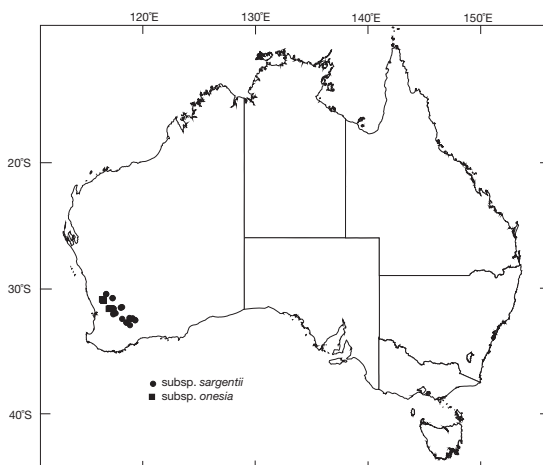
These taxa are found mainly in low-lying areas of poor drainage where the soils vary from sandy loams to clay loams derived from alluvial or aeolian deposits. Salt encrustations are usually evident on the soil surface.

Salt River gums occur either in woodlands, low woodlands or low open woodlands and, due to their tolerance of adverse soils, are found in association with or near various species adapted to saline situations. These include *E. celastroides* subsp. *virella*, York gum (*E. loxophleba*), *E. mimica*, *E. spathulata* subsp. *salina*, *E. myriadena* and wandoo (*E. wandoo*). Often they occur with paperbarks (*Melaleuca* spp.) and saltbushes (family Chenopodiaceae).

Related species: Brooker (2000) placed Salt River gum in subsection *Glandulosae*, series *Erectae*, distinguished by the glandular pith of the branchlets and the erect stamens in the bud. This series divides into three subseries, *Abundae*, recognised by the obscure leaf venation and great density of oil glands and the broad persistent staminal ring obscuring the disc, *Pedicellatae* which includes Salt River gum and which has distinct leaf venation and fewer oil glands and an annular disc, and *Annulatae*, a small group with crowded oil glands in the leaves and honeycombed seedcoats. Salt River gum is usually easy to recognise in the field because of its adaptation to low-lying, saline flats and the small green, olive green or bluish green adult leaves. The terete peduncles are characteristic of related species, viz. *E. stowardii* which is a mallee with larger, very glossy adult leaves not adapted to saline soils and of *E. diminuta* which has ovate to lanceolate seedling leaves, broader adult leaves and larger buds and fruits. Nicolle (2005) considers *E. sargentii* subsp. *fallens* (Hill and Johnson 1992) to be synonymous with *E. diminuta*.

Publication: Subsp. *sargentii*: Crit. Revis. *Eucalyptus* 7, 58 (1924). Type: Meares Lake, County Peak, Western Australia, Sep. 1910, O.H. Sargent 707. Subsp. *onesia*: *Nuytsia* 15: 395–402 (2005). Type: Cunderdin to York road, 19 April 1998, D. Nicolle 2238.

Names: Botanical—*sargentii*, after the collector of the type; Latin *onesis* (advantage, useful), referring to the potential for the form to be used in reclamation of saline sites. Common—



refers to a location from which the species was first collected (see Maiden 1924).

Bark: Rough and persistent on the lower part of the trunk, short-fibred, thin, hard, with shallow longitudinal fissures, grey-brown, coming off in long strips at the top to leave smooth red-brown bark which weathers to grey (*sargentii*), usually smooth (*onesia*). Basal rough bark becomes thicker and flakier with age.

Leaves: Seedling—opposite for a few pairs then alternate, petiolate, lanceolate to linear, 4.5–11 × 0.5–1.3 cm, greyish green, concolorous. Juvenile—alternate, petiolate, linear, up to 12 × 0.6 cm, greyish green, concolorous. Intermediate—alternate, petiolate, linear, 9.5–12 × 1–1.3 cm, green, concolorous. Adult—alternate, petiolate, linear to narrow-lanceolate, 6–10 × 0.5–1.3 cm, green to olive green or bluish green, concolorous.

Inflorescences: Simple, axillary, 7-flowered; peduncles slender, terete, angular, down-curved, 0.6–2 cm long; pedicels 0.1–0.5 cm long; buds elongated, cylindrical, 1.6–2.5 × 0.4–0.5 cm; opercula horn-shaped, straight or slightly curved, 2–3 times the length of the hypanthia. Flowers Sept.–Dec.

Fruits: Pedicellate, cupular, cylindrical or slightly pyriform, 0.7–1.1 × 0.5–1 cm; disc annular; valves 3 or 4, slender, slightly exserted. Seeds flattish-ovoid, brown, hilum ventral.

Wood: Heartwood pale brown, tough, straight-grained, density around 1000 kg m⁻³; rarely used due to scarcity of trees; bark astringent and rich in tannin.

Climate: Altitudinal range: 200–300 m; Hottest/coldest months: 33–34°C/4–5°C; Frost incidence: low to moderate (about 1–10 each year); Rainfall: 330–480 mm per year, winter max.

Distinctive features: Non-lignotuberous mallet with persistent rough bark on lower part of trunk (*sargentii*), or lignotuberous mallee with smooth bark (*onesia*), occurring in the vicinity of salt lakes; pith of branchlets glandular, narrow leaves at all stages; terete peduncles; slender exserted valves.



Eucalyptus sargentii 1. Adult leaf venation 2. Seedling 3. Juvenile leaves 4. Fruits 5. Adult leaves 6. Stand (subsp. *onesia*), between Cunderdin and Tammin, W.A. 7. Buds 8, 9. Bark

Swamp Mallet Swamp Gimlet, Narrow-leaved Gimlet

Eucalyptus spathulata Hook.

This species is a mallet or a low-branching shrub, without a lignotuber. It usually is 5–8 m tall but sometimes attains 10 m tall and bole diameter to 50 cm. It typically has a short trunk and steeply ascending branches that form a dense crown of crowded, conspicuously narrow leaves, which are held at very acute angles to the stems. There are two subspecies, the typical and subsp. *salina*.

This species is confined to the southern wheat belt of Western Australia. The southern typical and widely cultivated subsp. *spathulata*, occurs from the Lake Grace and Newdegate areas southwards to Ongerup and west to Wagin. The northern, less known subsp. *salina*, is restricted to the Salt River Flat area in the northern part of the southern wheat belt. The two subspecies occupy different drainage systems.

Swamp mallet is notably a species of saline drainage lines and depressions on heavy clay soils, often fringing salt lakes. Soils also include sandy loams but all are usually alkaline, moderately saline and poorly drained.

Swamp mallets occur in low woodlands and often form more or less pure stands. When other species are present they include *Melaleuca* spp., swamp oak (*Casuarina obesa*), *E. extensa*, Kondinin blackbutt (*E. kondininensis*), square-fruited mallee (*E. calycogona*) and swamp yate (*E. occidentalis*).

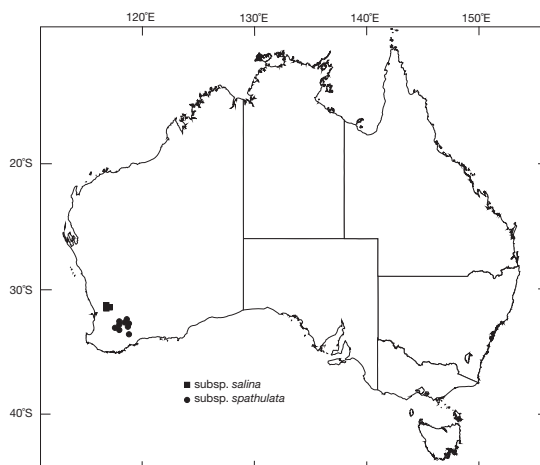
Related species: Swamp mallet belongs to a large group of species, endemic to Western Australia, recognised by the long opercula accommodating erect stamens. It is one of a small group of species within the series *Abundae* (Brooker 2000), characterised by relatively narrow leaves compared with those of the well-known, round-leaved moort (*E. platypus*). Swamp mallet is closely related to several other mallet species, viz. *E. alipes* which has larger, consistently 3-flowered inflorescences, to *E. steedmanii* which has the largest buds and fruit of the group, is 3-flowered, has persistent sepals, and buds ‘square’ in cross-section, and to *E. mimica* which is 3-flowered and has persistent sepals or opercula that persist to flowering. A related group, often confused with swamp mallet, comprising *E. suggrandis* and *E. orthostemon*, are mallees.

Publication: Subsp. *spathulata* *Icon. Pl.* 7:t. 611 (1844). Type: Swan River Colony, J. Drummond, Supp. Coll. No. 20. Subsp. *salina* *Nuytsia* 15: 403–430 (2005). Type: west of Pingaring on Cargonocking–Pingaring road, 16 Sep. 2000, D. Nicolle 3435 & M. French.

Names: Botanical—Latin *spathulatus* (spathulate, spatula-shaped), allusion obscure, thought to refer to the adult leaves which have a tapering base; *salinus* (saline, of salt), referring to the habitat. Common—referring to the habitat and habit.

Bark: Smooth, often with small persistent flakes, satiny, grey, salmon-coloured or coppery; contains up to 30 per cent tannins.

Leaves: Seedling—opposite for 2 or 3 pairs, then alternate, shortly petiolate, linear, 5–9 × 0.3–1 cm, first leaves dull, later ones glossy, green. Juvenile—alternate, shortly petiolate, linear, 3.5–5 × 0.3–0.5 cm, glossy, green. Adult—alternate, shortly petiolate, linear, (*spathulata*) 4.5–8 × 0.3–0.5 cm,



glossy, bluish green to slate-grey, concolorous; (*salina*) 4.5–8 × 0.4–0.7 cm, glossy, green, concolorous.

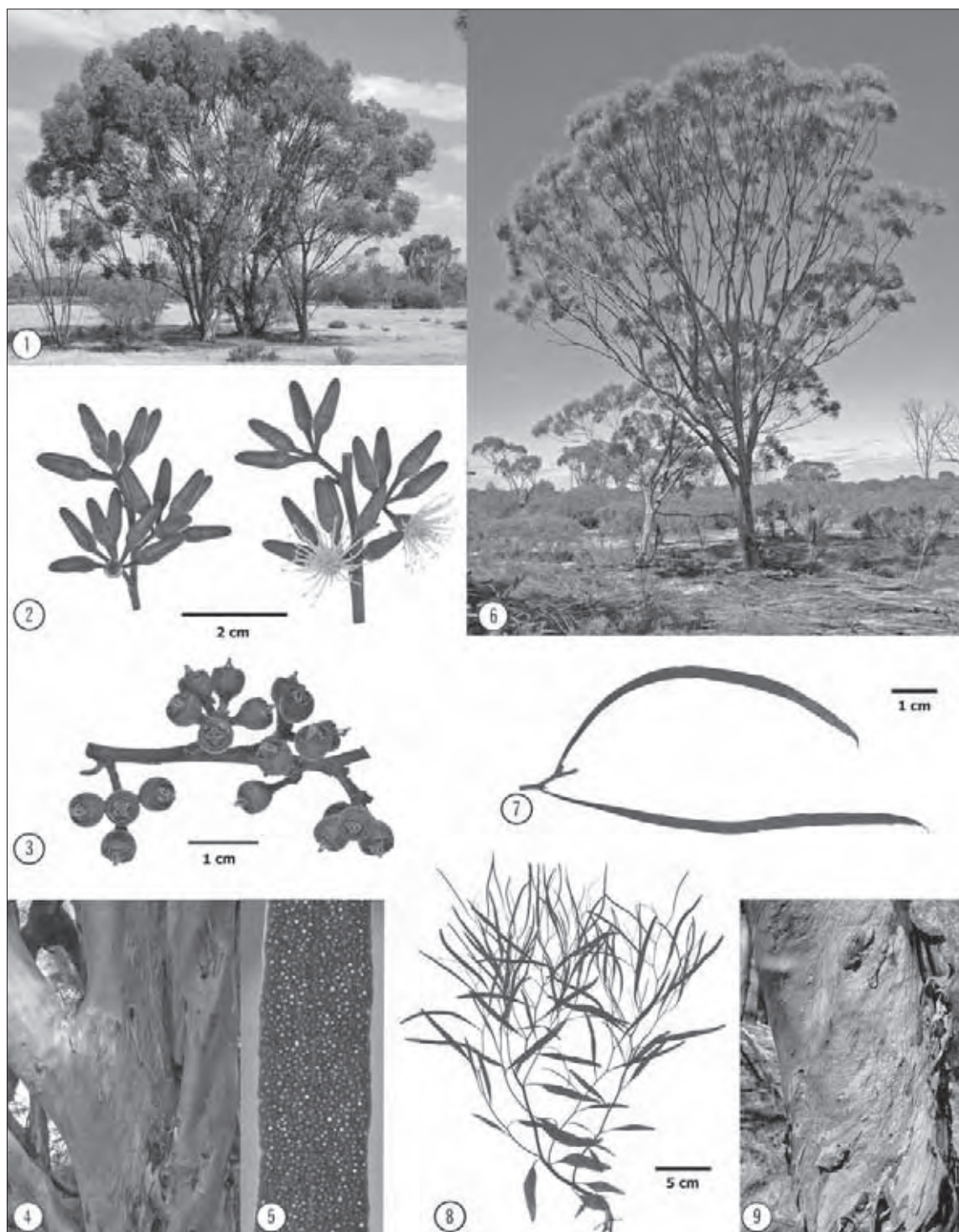
Inflorescences: Simple, axillary, 7-flowered (*spathulata*), 3 and/or 7-flowered (*salina*); peduncles flattened, 0.4–1.5 cm long; pedicels terete, 0.2–0.6 cm long; buds more or less cylindrical, 0.9–1.5 × 0.3–0.5 cm; operculum cylindrical, rounded (*spathulata*), or somewhat pointy (*salina*), narrower than hypanthium. Flowers Dec.–Mar.

Fruits: Shortly pedicellate, obconical to hemispherical, 0.4–0.7 × 0.4–0.6 cm (*spathulata*) or 0.6–0.8 × 0.6–0.7 cm (*salina*); staminophore broad, persistent, obscuring the disc; valves 3, slightly exserted (style remnants). Seeds ovoid to compressed-ovoid, brown, hilum ventral.

Wood: Pale brown, hard, density around 1000 kg m⁻³.

Climate: Altitudinal range: 250–380 m; Hottest/coldest months: 29–31°C/5°C; Frost incidence: low to moderate (about 1–20 each year); Rainfall: 320–430 mm per year, winter max.

Distinctive features: A non-lignotuberos marlock or mallet with smooth bark and a crown of conspicuously, crowded, narrow, linear leaves held at very acute angles to the stem; buds small, in 3s or 7s, with opercula narrower than hypanthia; notably confined to saline sites in the southern wheat belt.



Eucalyptus spathulata 1. Stand, near Katanning, W.A. 2. Buds 3. Fruits 4. Upper bark 5. Adult leaf venation 6. Tree, near Pingarup, W.A. 7. Adult leaves 8. Seedling 9. Lower bark

Coastal Moort

Eucalyptus utilis Brooker & Hopper

Coastal moort is usually a mallet 5 m tall or on more favourable sites up to 8 m tall with a dbh to 50 cm. It forms a densely foliated crown, and branching may be spreading and robust in open situations. Leaves are held at an acute angle to the stem giving the crown a uniform appearance.

This species has a fairly limited natural distribution in southern coastal and subcoastal Western Australia. It occurs east from Beaufort Inlet near Bremer Bay to the Esperance region, including Cape Arid and some islands in the Recherche Archipelago (e.g. Mondrain and Middle Islands). It is usually found within 50 km of the coast.

Coastal moort grows in lower parts of the topography in slight depressions or gentle rises in the vicinity of low-lying areas. Soil types are sands, sandy clays or sandy loams, usually alkaline, derived from limestone or alluvial sediments.

Like most mallet species coastal moort tends to form pure stands, which occur as densely spaced, low woodlands that preclude mixed association with other species. Other species in the vicinity include broombrush (*Melaleuca uncinata*) and mallee eucalypts such as ridge-fruited mallee (*E. angulosa*).

Related species: Coastal moort was placed in series *Erectae*, subseries *Abundae*, a group of about 10 species, endemic to Western Australia, recognised by the long opercula accommodating erect stamens and the abundant leaf oil glands (Brooker 2000). Species such as swamp mallet (*E. spathulata*), Steedman's mallet (*E. steedmanii*) and sand mallet (*E. eremophila*) belong in this group. Coastal moort is closest to moort (*E. platypus*), which differs in occurring on more inland sites that have heavier-textured soils and in having orbicular to very broadly elliptical adult leaves. Its close relationship with *E. platypus* is reflected in its formerly being recognised as *E. platypus* var. *heterophylla*, an inappropriate name corrected by Brooker and Hopper (2002).

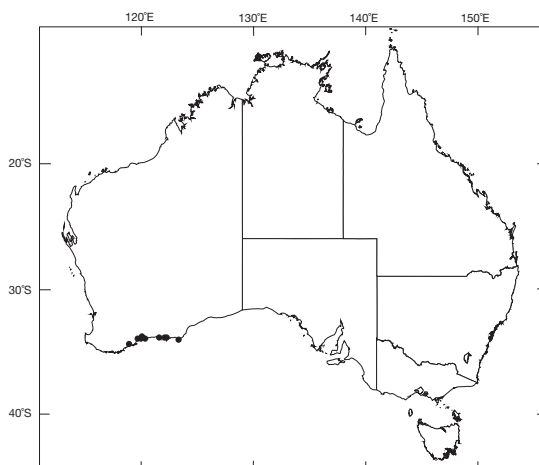
Publication: *Nuytsia* 14, 349 (2002). Type: Hopetoun, 19 Oct. 1964, C.A. Gardner 14888.

Names: Botanical—Latin *utilis* (useful), alluding to its use as an amenity plant. Common—of Aboriginal origin and to its coastal occurrence.

Bark: Smooth, grey to grey-green to orange-coppery depending on season; apparently contains useful quantities of tannins.

Leaves: Seedling—opposite for 2 or 6 pairs, then alternate, petiolate, deltoid to ovate, 2–5 × 1.5–3.5 cm, scabrid, pale green to green. Juvenile—alternate, petiolate, ovate, 2–8 × 1.5–3.5 cm, lowest leaves slightly scabrid, pale to green green. Adult—alternate, erect, petiolate, petiole to 2 cm long, elliptical to broad lanceolate 4.5–8 × 1–3 cm, glossy, green, concolourous, oil glands numerous.

Inflorescences: Simple, axillary, 7-flowered, peduncles erect, broadly flattened, to 3 cm long; buds shortly pedicellate, fusiform, to 2.6 × 0.6 cm; opercula horn-shaped, sometimes slightly warty, narrower than hypanthia; hypanthia two-ribbed. Flowers Dec.–Feb.

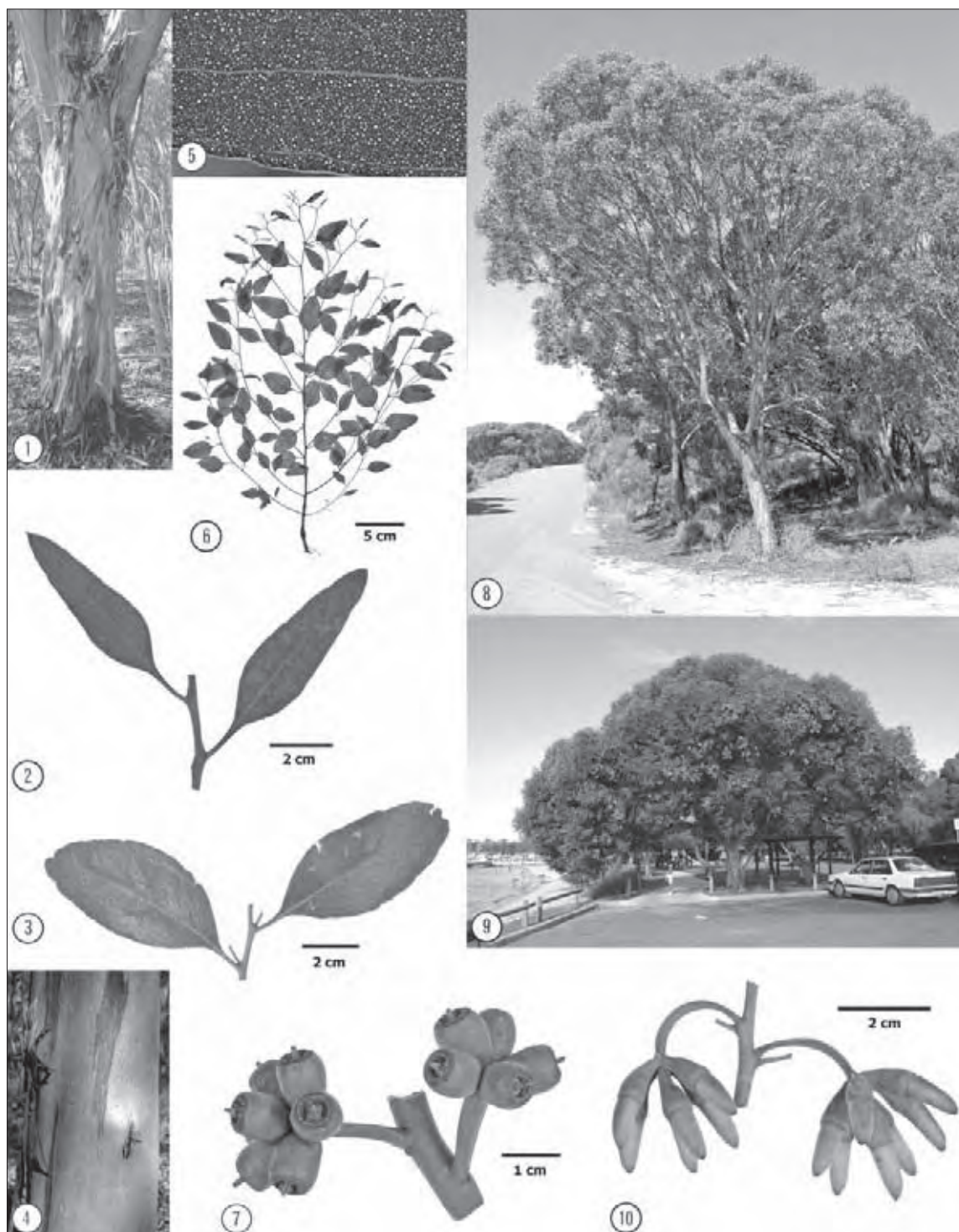


Fruits: Sessile or shortly pedicellate, more or less obconical, to 0.7–1 × 0.7–1 cm; staminophore broad, disc descending; valves 3 or 4, at rim level or tips very slightly exerted (style remnants), weakly two-ribbed. Seeds ovoid to compressed-ovoid, blackish brown, hilum ventral.

Wood: Pale brown, hard, durable, used for fence posts, density around 1050 kg m⁻³.

Climate: Altitudinal range: near sea level to 200 m; Hottest/coldest months: 26–27°C/6–7°C; Frost incidence: low; Rainfall: 450–700 mm per year, winter max.

Distinctive features: A non-lignotuberos mallet with smooth bark and densely foliated crown of ascending leaves; heterophyllous leaf stages; buds in 7s on long, broadly flattened peduncles, opercula narrower than hypanthia; confined to coastal and subcoastal sites. A common amenity plant, particularly in the urban south-west of Western Australia; also used in shelterbelts in agricultural regions.



Eucalyptus utilis 1. Bole, Beaufort Inlet, W.A. 2. Adult leaves 3. Intermediate leaves 4. Bark 5. Adult leaf venation 6. Seedling 7. Fruits 8. Tree, near East Mount Barren, W.A. 9. Cultivated amenity plant, East Fremantle, W.A. 10. Buds

Wandoo and Wheatbelt Wandoo

Eucalyptus wandoo Blakely and *E. capillosa* Brooker & Hopper

These species are usually medium-sized trees up to 10–25 m in height and to 0.8 m dbh, but are occasionally found up to 30 m tall and 1 m dbh. Wandoo consists of two subspecies, the typical and subsp. *pulverea*, while wheatbelt wandoo includes the typical tree and a mallee form, subsp. *polyclada*.

Subsp. *wandoo* occurs mainly in the foothills and hills of the Darling Range north to about Gin Gin and Bindi Bindi. To the south it occurs in the Stirling Range and south-east to the lower Pallinup River. There is an outlier east of Narambeen in the southern wheat belt. Subsp. *pulverea* is the northern form from Cataby to Morawa. Subsp. *capillosa* is prominent east of Pithara, Kellerberrin and Narrogin, while subsp. *polyclada* occurs in the lower northern wheat belt.

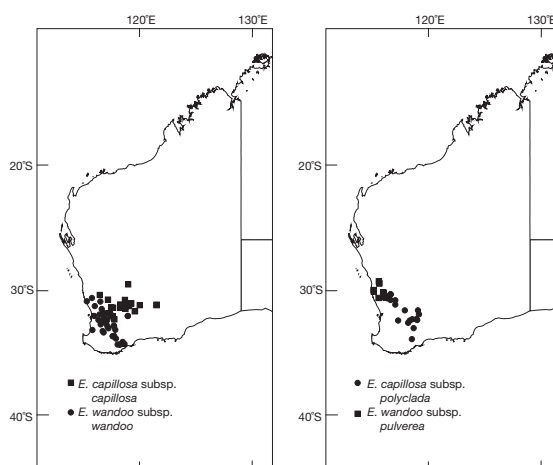
The best wandoo forests occur from between Darkan and Quindanning to Toodyay, either in broad shallow valleys or on low ridges. Elsewhere it grows on the lateritic plateau of the Darling Range or extends onto the drier inland plains to the east as well as a smaller area on the coastal plains south of Perth. Soils dark brown loamy sands or sandy loams containing some gravel. Wheatbelt wandoo prefers heavy soils and in the eastern part of its distribution between Southern Cross and Coolgardie occurs at the base of granite rock outcrops.

Wandoo taxa occur in open forests, woodlands, low woodlands or tall shrublands. Numerous eucalypts are associated with these taxa. Associates of subsp. *wandoo* include powderbark wandoo (*E. accedens*), jarrah (*E. marginata*) and marri (*E. calophylla*), while salmon gum (*E. salmonophloia*) and redwood (*E. transcontinentalis*) occur with subsp. *capillosa*. Species ranging from gimlet (*E. salubris*), fluted horn mallee (*E. stowardii*) and sand mallee (*E. leptopoda*) occur with subsp. *polyclada*, while species such as York gum (*E. loxophleba*) and prickly bark (*E. todtiana*) occur with subsp. *pulverea*.

Related species: Wandoo belongs to the large series *Levispermae* (Brooker 2000). In the Darling Range, wandoo may be confused with powderbark wandoo (*E. accedens*), which tends to occupy stony ridges upslope from wandoo. Darling Range ghost gum (*E. laeliae*) occupies part of the western scarp of the Darling Range. Both these species have buds with short opercula compared with the fusiform buds of wandoo.

Publication: *Eucalyptus wandoo*: Key *Eucalypts*, 112 (1934). Type: Kalgan River, Western Australia, A.F. Oldfield. Subsp. *pulverea*: *Nuytsia* 8, 40 (1991). Type: 8.7 km N of Watheroo, Western Australia, 3 Feb. 1988, M.I.H. Brooker 9885 & C. Sounness. *E. capillosa* subsp. *capillosa*: *Nuytsia* 8, 41 (1991). Type: 9.5 km N of Merredin on Nungarin road, 15 Sep. 1982, M.I.H. Brooker 7620. Subsp. *polyclada*: *Nuytsia* 8, 45 (1991). Type: 4.8 km NE of Kulin on Kondinin road, Western Australia, 14 Sep. 1988, M.I.H. Brooker 10075.

Names: Wandoo is an Aboriginal name used for the ‘gum’ of this species; Latin *capillosus* (with hairs), referring to the seedlings compared with the glabrous seedlings of *E. wandoo*; Greek, *poly* (many) and *clados* (branch) refers to the mallee habit; Latin *pulvereus* (powdery) refers to the bark.



Bark: Smooth throughout, yellow (*wandoo*), or pale orange (*pulverea*) when newly exposed, weathering to white, non-powdery (*wandoo*), powdery (*pulverea*) or bright orange (*capillosa*). Saplings and young trees of *E. wandoo* have persistent, subfibrous, flaky, yellow-brown bark.

Leaves: Seedling—opposite for 3 or 4 pairs then alternate, petiolate, cordate to ovate, 5–10 × 2.5–5 cm, bluish green, concolorous, glabrous (*wandoo*), pubescent (*capillosa*); greyish blue, concolorous. Juvenile—alternate, petiolate, ovate to broad-lanceolate, 9–13 × 3–10 cm; colour and hairs as for seedling stage. Intermediate—alternate, petiolate, lanceolate, 10–16 × 2–4 cm, green to greyish green, dull, concolorous, glabrous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 8–15 × 1–2.4 cm, green to greyish green, dull, concolorous, glabrous.

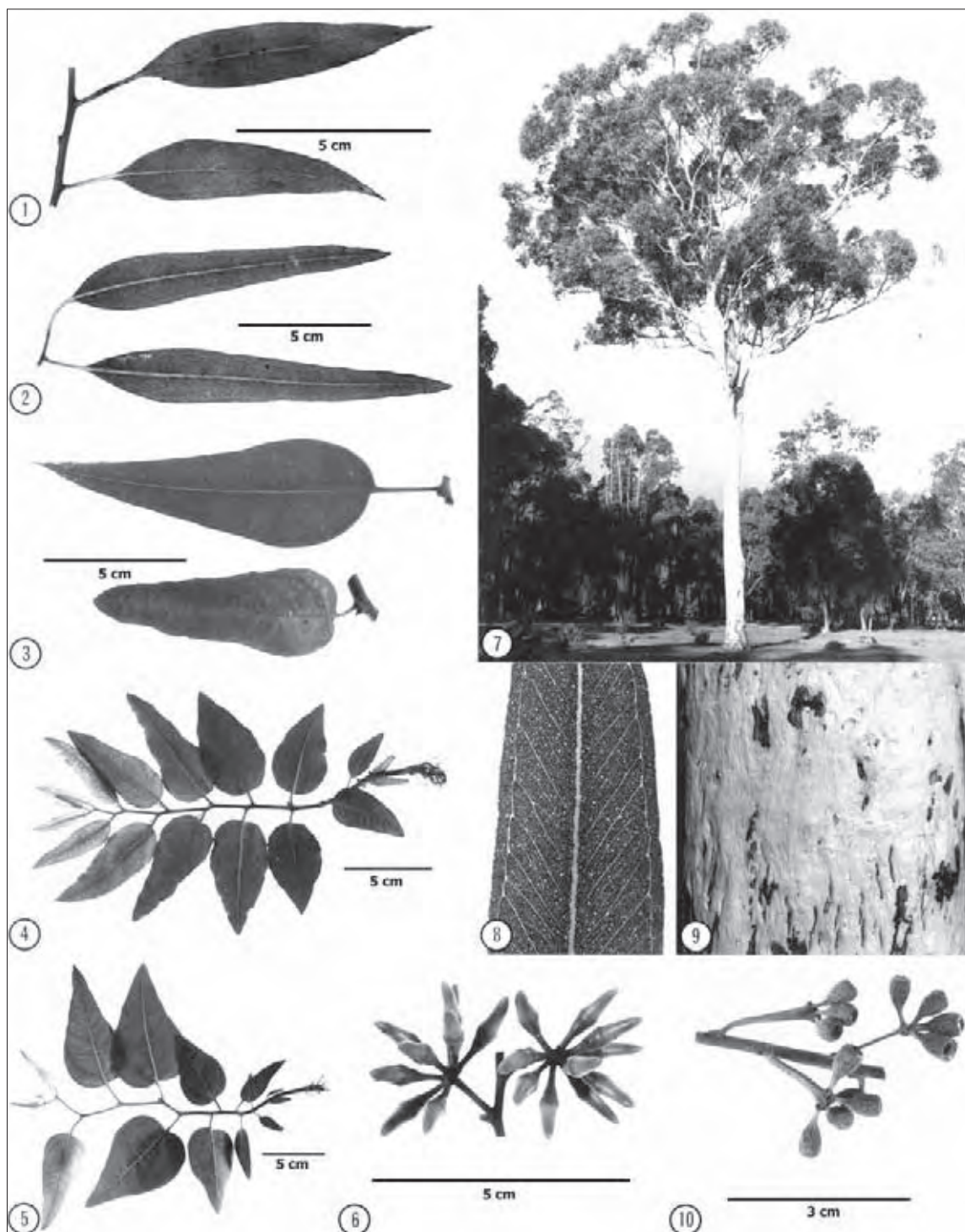
Inflorescences: Simple, axillary, 11 to 17-flowered; peduncles slender, angular to flattened, 1.5–2 cm long; pedicels 0.1–0.5 cm long; buds fusiform, 1–2.1 × 0.3–0.4 cm; operculum horn-shaped, 1–2 times the length of the hypanthium. Flowers Nov.–Apr.

Fruits: Pedicellate, obconical to cylindrical, 0.5–1 × 0.3–0.6 cm; disc descending almost vertically; valves 3(4), erect, about rim level or slightly exserted. Seeds subspherical to cuboid, light brown to grey-brown, hilum ventral.

Wood: Heartwood yellowish to light reddish brown, fine-textured, with wavy or interlocked grain, very hard and very strong, tough, stiff; not susceptible to *Lyctus* and termite attack, it is one of the toughest and most durable eucalypt woods; density about 1040–1155 kg m⁻³; used for railway sleepers, poles, flooring, and all forms of heavy and light construction. Wandoo forests are now more valued for watershed protection and recreation. The bark and wood contain commercial quantities of tannins.

Climate: Altitudinal range: 100–300 m; Hottest/coldest months: 30–35°C/4–6°C; Frost incidence: low to moderate (1–20 each year); Rainfall: 400–700 mm per year, winter max.

Distinctive features: A white-barked gum; opercula long, horn-shaped; seed smooth.



Eucalyptus wandoo: *E. wandoo* (w), *E. capillosa* (c) 1. Adult leaves 2. Intermediate leaves 3. Juvenile leaves: upper, between York and Quairading, W.A (w); lower, near Westonia (c), W.A. 4. Seedling, east of Southern Cross, W.A. (c), 5. Seedling, east of York, W.A. (w) 6. Buds 7. Tree, west of York, W.A. (w) 8. Adult leaf venation 9. Bark 10. Fruits

Blue Mallet

Eucalyptus gardneri Maiden

Blue mallet is an erect tree up to 10 m tall, having a lower trunk dbh up to 40 cm. It usually branches low and steeply to form a terminal crown of conspicuously dull, bluish leaves. There are two subspecies, the typical and subsp. *ravensthorpensis*, a minor variant which mainly differs in having shorter buds.

Typical blue mallet occurs mainly in the west central wheat belt of Western Australia. It extends south from the Willams–Brookton area to Narambeen with a smaller occurrence in the northern wheat belt east of Cadoux. The minor variant subsp. *ravensthorpensis* is restricted to the Ravensthorpe Range.

Blue mallet occurs only on lateritic breakaways (rock outcrops) or rises. Soils are sandy with a conspicuous orange-yellow, ironstone gravel component and light clay at depth.

This species grows in low woodlands often in pure stands or as a dominant species. Other species associated or in the vicinity include brown mallet (*E. astringens*), silver mallet (*E. argyphaea*), green mallet (*E. clivicola*), wheatbelt wandoo (*E. capillosa*) and tallerack (*E. pleurocarpa*).

Related species: Blue mallet belongs to the large series *Levispermae* whose species are notable for their smooth, almost spherical or cuboid seed, flat peduncles, which widen towards the top, and the horn-shaped opercula (Brooker 2000). Blue mallet is placed in subseries *Levispermae* with the mallee black marlock (*E. redunca*), as both share the smooth seeds that give the series and subseries their name. Other mallets it may be confused with are brown mallet (*E. astringens*) and green mallet (*E. clivicola*), which differ most conspicuously by the glossy green leaves; *E. densa* differs in having a lower stature, narrower leaves and preferring heavier soils. Blue mallet is also close to *E. pluricaulis* in the buds and fruits, but this species is distinguished by the mallee habit. Over 30 new taxa were recognised in a revision of series *Levispermae* by Brooker and Hopper (1991).

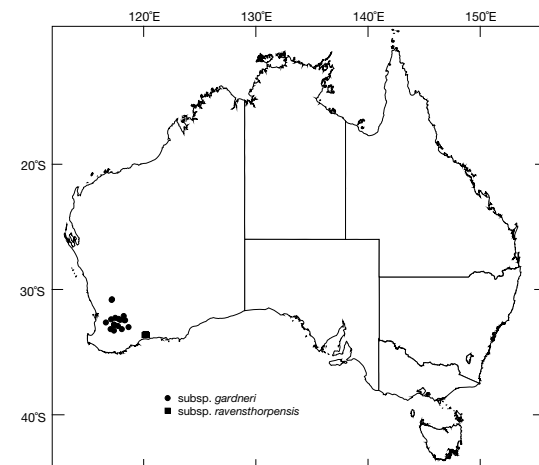
Publication: Subsp. *gardneri*: *Crit. Revis. Eucalyptus* 7, 53 (1924). Type: Bendering, Western Australia, 6 Feb. 1922, C.A. Gardner 1239. Subsp. *ravensthorpensis*: *Nuytsia* 8, 145 (1991). Type: Ravensthorpe Range, 800 m ENE of Highway 1 along Carlingup Road, 800 m NNW to revegetating gravel tip, 10 Apr. 1991, S.D. Hopper 7929.

Names: Botanical—after C.A. Gardner (1896–1970), Government Botanist in Western Australia and after the Ravensthorpe Range. Common—referring to the adult leaf colour and its tree habit.

Bark: Smooth throughout, with partly shed curls of dead bark, brown or coppery; contains up to 30 per cent tannin.

Leaves: Seedling—opposite for 2–4 pairs, shortly petiolate, deltoid to ovate, 6.5–11 × 1.3–3 cm, slightly glossy, bluish green or purplish. Juvenile—alternate, petiolate, deltoid to ovate, to 10 × 6 cm, slightly glossy, bluish green. Adult—alternate, petiolate, narrow-lanceolate to narrowly elliptical 5–9 × 1–2.3 cm, dull bluish to blue-grey, concolorous.

Inflorescences: Simple, axillary, 9 to 11-flowered; peduncles flattened, to 2 cm long; pedicels 2–3 mm long; buds fusiform, up to 2.6 cm long and 0.5 cm wide; opercula long, narrow,



finely recurved at the tip, usually > 1.5 cm long (*gardneri*), < 1.5 cm long (*ravensthorpensis*). Flowers Aug.–Dec.

Fruits: Pedicellate, elongated-barrel-shaped, 0.8–1.1 × 0.5–0.7 cm; valves three, enclosed and near rim level. Seeds almost spherical, light grey-brown, hilum ventral.

Wood: Light-coloured, dense and hard; has been used for poles, rails and in buildings.

Climate: Altitudinal range: 200–380 m; Hottest/coldest months: 30–32°C/5–6°C; Frost incidence: moderate (about 1–20 each year); Rainfall: 320–420 mm per year, winter max.

Distinctive features: A non-lignotuberous mallet usually on lateritic breakaways; smooth bark with partly shed curls of dead bark; pith glands sparse, sometimes absent; adult leaves dull bluish to blue-grey; buds fusiform; seeds more or less spherical, smooth.



Eucalyptus gardneri: subsp. *gardneri* (g), subsp. *ravensthorpensis* (r) 1. A—fruits, B—buds (g) 2. A—fruits, B—buds (r) 3. Intermediate leaves (g) 4. Seedling (g) 5. Tree, Karlgarin Hill, W.A. (g) 6. Adult leaves (g) 7. Juvenile leaves (g) 8. Bark (g) 9. Adult leaf venation (g)

Powderbark Wandoo

Eucalyptus accedens W. Fitzg.

Powderbark wandoo is a medium-sized tree, commonly attaining 20–25 m in height, with a comparatively large bole. The trunk is usually straight but often at one-quarter to one-third of the tree height it either divides into several stems or branches heavily.

Powderbark wandoo occurs in the south-west of Western Australia, north, east and south-east of Perth in a belt about 250 km long and 40–160 km from the coast. Most of this area is in the Darling Range or its northern extension. The species has a very limited occurrence on the coastal lowlands in the north of its distribution, e.g. west of Moora.

This species typically grows on the lateritic tops of hills of the Darling Range often above the areas favoured by wandoo. The slopes of the range vary from gentle to steep, while it occurs to a lesser extent on flat country. The soils are commonly gravelly lateritics or conglomerates and often rocky, but best growth is on brown clay loams.

Powderbark wandoo usually occurs in open forests with several other eucalypts, including wandoo (*E. wandoo*), brown mallet (*E. astringens*) and marri (*E. calophylla*). In the north-west of its distribution it occurs as a small tree on white sands in mallee heath and may be associated with other eucalypts such as northern sandplain mallee (*E. gittinsii*) and mallalie (*E. eudesmioides*).

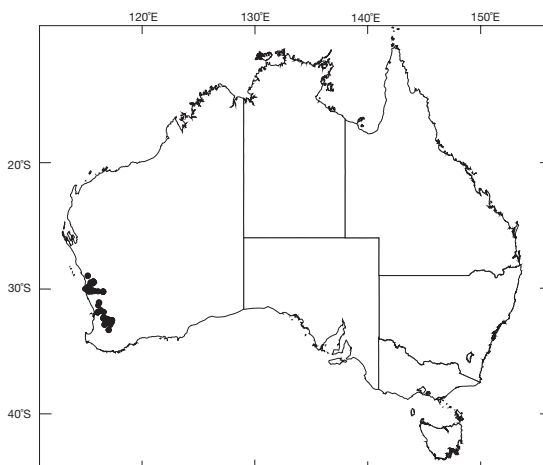
Related species: Powderbark wandoo belongs in the series *Accedentes* with seven other species, five of which are mallees and easily distinguished by their habit (Brooker 2000). The series is a mixed group, and the arid zone and desert mallees are taxonomically distant from the southern species. In the Darling Range powderbark wandoo was earlier confused with Darling Range ghost gum (*E. laeliae*), a smooth, white-barked tree that only occurs on the western scarp of the Darling Range and has smaller buds, fruits and leaves. Powderbark wandoo is easily distinguished from wandoo (*E. wandoo*), which has non-powdery bark, never prominently pink, and smaller buds with a beaked conical opercula.

Publication: *J. West. Austral. Nat. Hist. Soc.* 1, 21 (1904). Type: Near Pingelly, Western Australia, Nov. 1903, W.V. Fitzgerald.

Names: Botanical—Latin *accedens* (approaching, near to), perhaps in allusion to its (superficial) similarity to *E. wandoo*. Common—refers to the bark; wandoo is of Aboriginal origin.

Bark: Shed to ground level but with small, brown flakes being held for a time after principal bark shed. The presence of these flakes attached to small depressions has earned for the tree a local name of ‘spotted gum’. The new bark is covered with a pinkish powder, which readily rubs off to leave a smooth, whitish surface.

Leaves: Seedling—opposite for only 1 or 2 pairs, then alternate, petiolate, ovate to orbicular, often cordate, 5–8 × 4–7 cm, greyish blue, concolorous or slightly discolorous. Juvenile—alternate, petiolate, ovate to orbicular or cordate, 7–15 × 6–11 cm, greyish blue, concolorous. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 11–17 × 3–5 cm, dull, bluish green or grey-green, concolorous.



Adult—alternate, petiolate, broad-lanceolate to lanceolate, 7–18 × 1.2–3 cm, dull, bluish green or grey-green, concolorous.

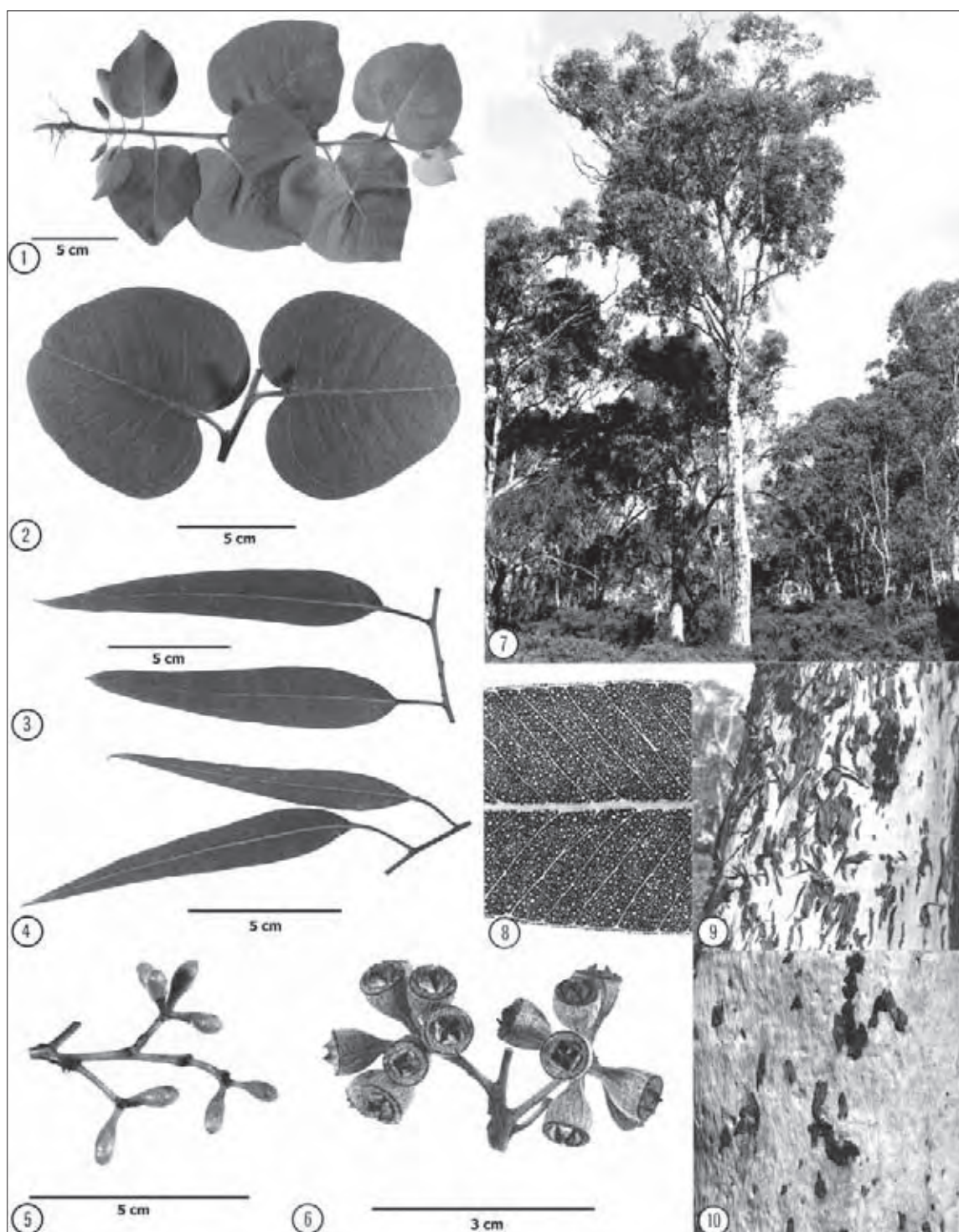
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles flattened, 0.7–1.4 cm long; pedicels angular, 0.2–0.6 cm long; buds ovoid to clavate, 1–1.4 × 0.4–0.7 cm; opercula hemispherical or conical. Flowers Dec.–Apr.

Fruits: Pedicellate, cylindrical to pyriform, 0.9–1 × 0.6–0.9 cm; disc moderately broad, descending; valves (3)4, erect, slightly below rim level to slightly exerted. Seeds flattened-ovoid, flanged, grey-brown to red-brown, almost smooth, hilum ventral.

Wood: Heartwood dark red, heavy, hard, strong and tough, density 960–1170 kg m⁻³; an exceptional timber of limited availability and with limited uses because of its weight and hardness. Wood is similar to wandoo (*E. wandoo*).

Climate: Altitudinal range: 150–400 m; Hottest/coldest months: 30–35°C/4–7°C; Frost incidence: low to moderate (up to 20 each year); Rainfall: 450–1000 mm per year, winter max.

Distinctive features: A gum with a pinkish powder bark; scattered small flakes of old bark may be retained for a time; pith of branchlets glandular; juvenile leaves large, greyish blue, ovate, orbicular or cordate.



Eucalyptus accedens 1. Seedling 2. Juvenile leaves 3. Intermediate leaves 4. Adult leaves 5. Buds 6. Fruits 7. Stand, between York and Perth, W.A. 8. Adult leaf venation 9, 10. Bark

Gimlet

Eucalyptus salubris F. Muell.

Gimlet is a small to medium-sized tree commonly 8–15 m but occasionally up to 25 m tall and 0.6 m dbh. It has steeply angled limbs and often the branching may occur near ground level or up to about half the tree height. The trunks are characteristically smooth and spirally fluted (more pronounced in younger trees) and the canopy moderately dense and terminal.

Gimlet is abundant and widespread in the wheat belt and goldfields area in the south-west of Western Australia. It occurs as far north as Mullewa and as far east as Laverton, Queen Victoria Spring and the plains north of Mt Ragged.

The main occurrence of gimlet is on plains or diffuse valleys. It grows on a variety of soils from sandy loams to clays but prefers good loamy soils with a high proportion of clay. As a result it often forms pure stands in relatively low sites, which are less suitable for other eucalypts, which may be on nearby lighter soils.

Gimlet grows mainly in open eucalypt woodlands often associated with species such as salmon gum (*E. salmonophloia*), redwood (*E. transcontinentalis*), mirret (*E. celastroides*), square-fruited mallee (*E. calycogona*), square-fruited mallet (*E. prolixa*) and capped mallee (*E. pileata*). On drier or sandier sites it may form pure stands and be associated with a sparse ground layer of spinifex (*Triodia* sp.) and bluebushes (*Maireana* spp.).

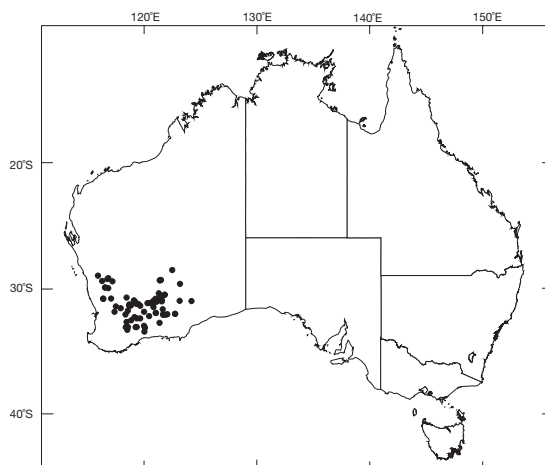
Related species: Gimlet belongs to series *Contortae* (Brooker 2000), a group of eight mallets and one mallee (*E. effusa*), the latter being easily distinguished in the series by its low straggly habit and loose fibrous bark. *E. salubris* is closely related to silver gimlet (*E. campaspe*) and *E. ravida* (formerly *E. salubris* var. *glauca*), two species of more restricted distribution within the area of occurrence of gimlet, and which are readily distinguished in the field by their pruinose branchlets, buds and fruits and the more bluish leaves. Two-winged gimlet (*E. diptera*) differs from gimlet in having larger sessile buds and fruits, which are borne in threes or even singly and lack a peduncle. *E. terebra* is a more umbrageous tree mainly from between Norseman and Balladonia, with larger buds and fruits held in tight clusters of 7s. Gimlets and related species were revised by Johnson and Hill (1991).

Publication: *Fragm.* 10, 54 (1876). Type: Between Victoria Spring and Ularung, Western Australia, 9 Oct. 1875, J. Young.

Names: Botanical—Latin *salubris* (wholesome, chiefly of climate, air, etc.), refers to what Mueller considered the 'sanitary importance of the tree'. Common—refers to the spiral fluting of the trunks of this species which bear similarities to a gimlet.

Bark: Smooth to ground level, shining, strikingly copper-coloured when newly exposed; weathering to green-brown and grey-brown, characteristically fluted with broad, spiral ribbing; contains 18–20 per cent tannins.

Leaves: Seedling—opposite for few pairs then alternate, petiolate, ovate to broad-lanceolate, 3.5–6.5 × 1.3–2.4 cm, green, concolorous. Juvenile—alternate, petiolate, lanceolate, 6.5–11 × 1.5–2 cm, green, concolorous. Intermediate—



alternate, petiolate, lanceolate, 10–12.5 × 1.4–2.1 cm, glossy green, concolorous. Adult—alternate, petiolate, narrow-lanceolate, 4.5–10.5 × 0.5–1.3 cm, glossy green, concolorous.

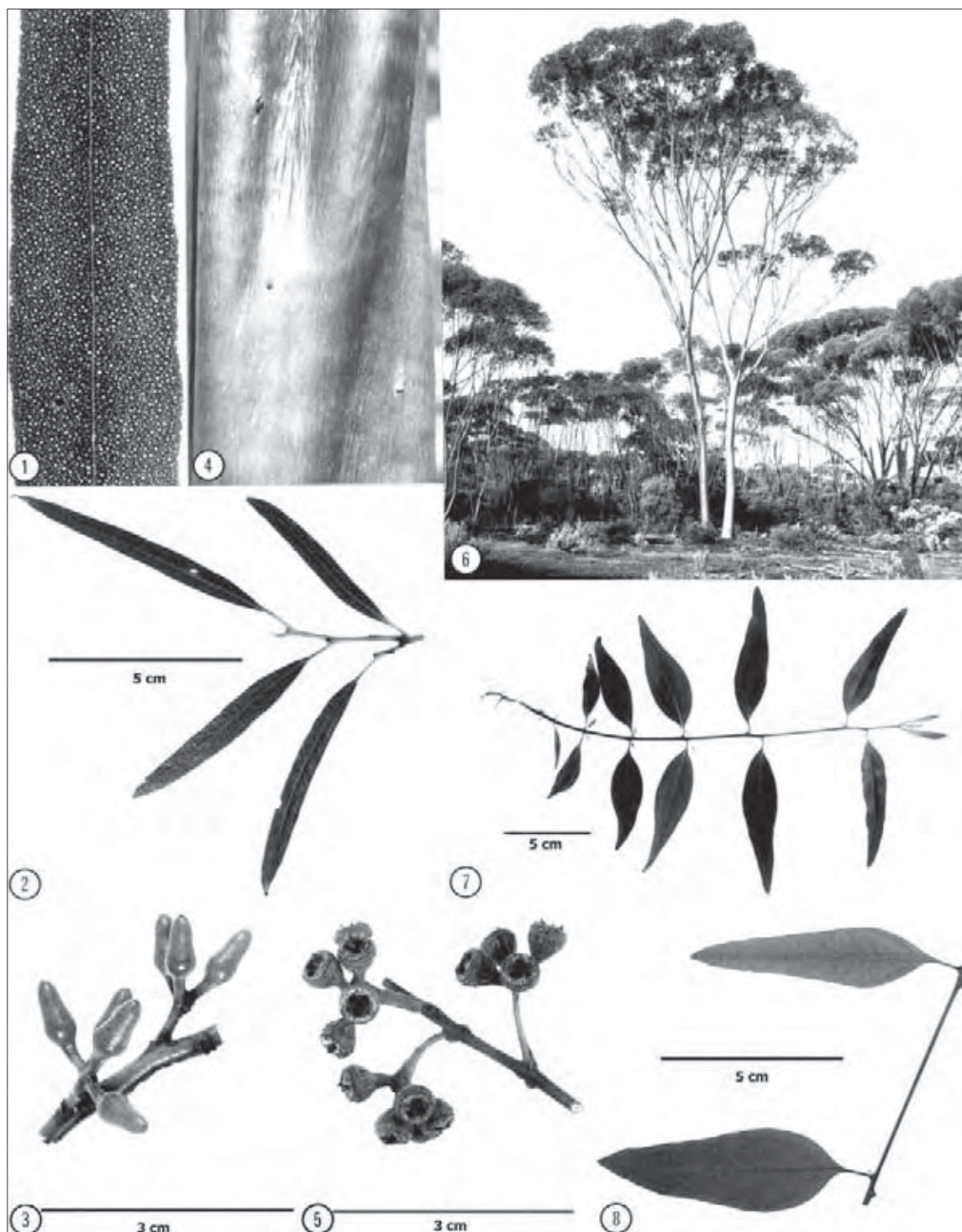
Inflorescences: Simple, axillary, 7-flowered; peduncles always flattened and stout, 0.4–1.3 cm long; pedicels sometimes absent, or up to 0.7 cm long; buds ovoid, 0.8–1.2 × 0.35–0.5 cm; opercula broadly conical, usually rounded at the top. Flowers Sept.–Dec.

Fruits: Sessile or pedicellate, hemispherical or obconical, 0.3–0.6 × 0.5–0.7 cm; disc level to ascending or descending; valves 3 or 4, exserted, sometimes curved outwards. Seeds flattish ovoid or cuboid, yellow-brown, pitted, hilum ventral.

Wood: Heartwood brown to dark brown with a pinkish, reddish to sometimes greyish mauve or orange tint, grain interlocked, fine-textured, dense, strong; used formerly as firewood in gold-mining areas; useful for poles, posts and minor construction in the wheat belt and goldfields; density 955–1185 kg m⁻³; its grain makes it attractive for furniture although its relatively small size may be a limitation. Recent uses include as head joints for flutes and sawn timber.

Climate: Altitudinal range: 100–350 m; Hottest/coldest months: 31–37°C/4–7°C; Frost incidence: low to moderate (up to 10 each year); Rainfall: 230–400 mm per year, winter max.

Distinctive features: A non-lignotuberos small tree with an upright branching habit and smooth, fluted, shining, copper-coloured trunks and branches; pith of branchlets strongly glandular; very glossy, dark green adult leaves; stout, broad peduncles; long anthers; seed with a yellow, honeycombed seedcoat.



Eucalyptus salubris 1. Adult leaf venation 2. Adult leaves 3. Buds 4. Bark 5. Fruits 6. Stand, east of Norseman, W.A. 7. Seedling 8. Juvenile leaves

York Gum

Eucalyptus loxophleba Benth.

York gum varies from a small tree 5–15 m tall with a dbh up to 0.6 m and of reasonable form to a low, straggly mallee. There are four subspecies.

Subsp. *loxophleba* is the tree form of the western part of the wheat belt in southern Western Australia, from Moora in the north, south to Kojonup and Borden, and eastwards to about Merredin and Hyden. Subsp. *lissophloia*, a mallee form, occurs in the eastern wheat belt and goldfields, extending from Bencubbin and Merredin east to as far as Karonie and Coonana and south-east almost to Balladonia and Peak Charles. Subsp. *gratieae*, also a mallee, is restricted to the southern wheat belt from Nyabing to east of Hyden and subsp. *supralaevis* is the northern tree form and occurs from Dongara and Wongan Hills in the south-east to Westonia and Mt Jackson and north-west to Wannoo south of Shark Bay.

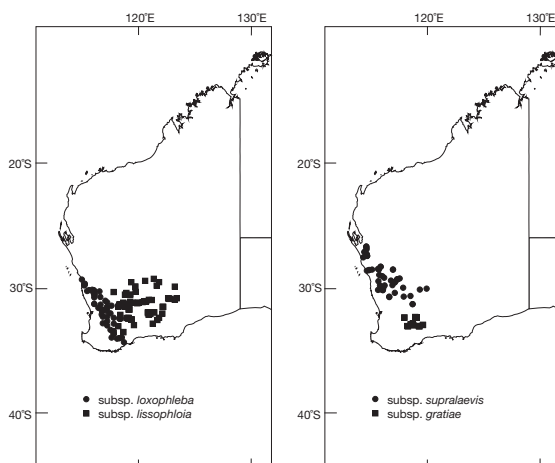
Subsp. *loxophleba* occurs on undulating slopes of the eastern Darling Range and plains and low hills of the western wheat belt. It prefers sandy to medium density loams but will grow on both lateritic and moderately heavy texture soils. Subsp. *gratieae* and subsp. *lissophloia* grow mainly on shallow sandy soils over clay often derived from granite; while *supralaevis* occurs mainly on plains and soils are deep red loams.

These taxa are usually found in remnant woodlands, which formerly covered much of what is now wheat and sheep country. Subsp. *lissophloia* and subsp. *supralaevis* also occur in tall shrublands in drier parts of their ranges. Associated eucalypts include wandoo (*E. wandoo*), salmon gum (*E. salmonophloia*), gimlet (*E. salubris*) and powderbark wandoo (*E. accedens*); jam (*Acacia acuminata*) is also common.

Related species: York gum belongs to series *Loxophlebae*, which comprises three other geographically restricted species, *E. articulata*, *E. blaxellii* and *E. semota* (Brooker 2000). Ponton Creek mallee (*E. articulata*) is a low mallee restricted to sand hills in the Great Victoria Desert; Howatharra mallee (*E. blaxellii*) is a low glossy-leaved mallee known only from the Moresby Range north of Geraldton; and Marymia mallee (*E. semota*) is a small tree or mallee with rough bark known only from laterite breakaways north-east of Meekatharra. The peculiar leaf venation, pseudo-terminal inflorescences, strongly elbowed stamens and style with a basal constriction and the bluish juvenile leaves, readily distinguishes all subspecies of York gum from other species.

Publication: Subsp. *loxophleba*: *Fl. Austral.* 3, 252 (1867). Syntypes include Darling Range, A. Collie, and Swan River, J. Drummond, Western Australia. Subsp. *gratieae*: *Nuytsia* 1, 248 (1972). Type: 0.5 km W of Burngup, Western Australia, 3 Nov. 1969, M.I.H. Brooker 2273. Subsp. *lissophloia*: *Telopea* 4, 569 (1992). Type: Cardunia Rocks, 16 Sept. 1978, D.F. Blaxell 1749 and L.D. Pryor. Subsp. *supralaevis*: *Telopea* 4, 568 (1992). Type: 16.6 km W of highway on fence line 57.7 km N of Murchison River, 21 Nov. 1986, K.D. Hill 2569, L.A.S. Johnson, D.F. Blaxell, and M.I.H. Brooker.

Names: Botanical—Greek *loxos* (crooked, slanting), *phleps* (vein), presumably of the leaf venation. Common—subsp. *loxophleba*: refers to the town of York, where it is common..



Bark: In the tree form (*loxophleba*), rough and persistent over most of the trunk, hard, grey-brown to dark grey, with shallow longitudinal fissures. In subsp. *supralaevis* the bark is rough only on the lower half of the trunk and in the mallee forms (*gratieae*, *lissophloia*), the bark is smooth, coppery to light grey with pruinose upper branches and branchlets.

Leaves: Seedling—opposite for 4–6 pairs then alternate, petiolate, ovate, sometimes cordate, 4.5–8 × 2.5–7 cm (largest in *gratieae*), greyish green to bluish green, concolorous. Juvenile—alternate, petiolate, ovate, sometimes cordate, 8–13 × 5.5–9 cm (largest in *gratieae*), greyish green to bluish green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 7.5–16 × 0.8–3.3 cm (largest in *gratieae*), glossy green, concolorous, with prominent venation and the intramarginal vein remote from the leaf edge.

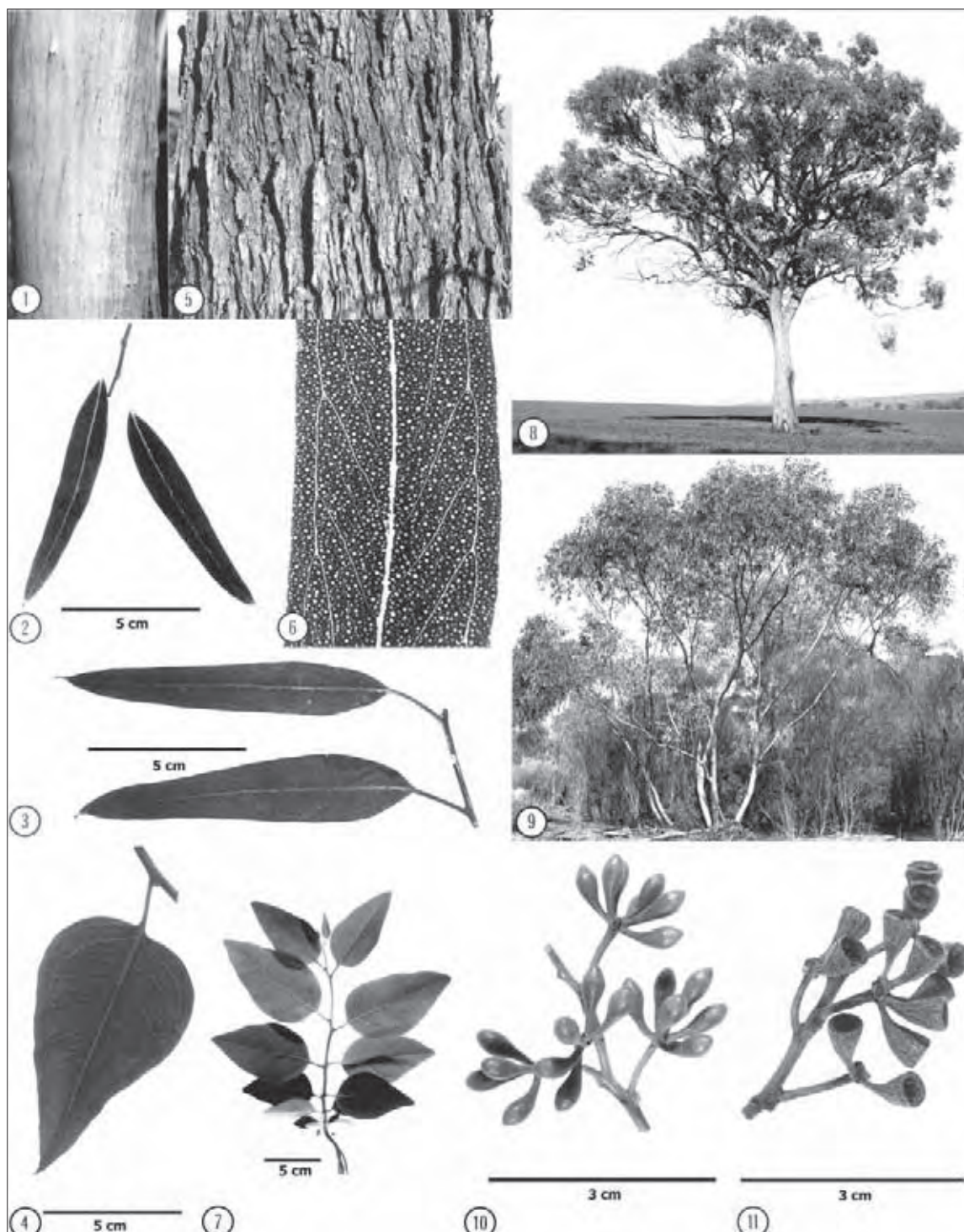
Inflorescences: Simple and axillary when mature, often compounded into small, terminal pseudo-panicles in early growth, 7 to 11-flowered; peduncles terete to angular, 0.3–2.4 cm long; pedicels 0.1–0.4 cm long; buds clavate, 0.6–1.5 × 0.3–0.5 cm; opercula conical, hemispherical or hemispherical-apiculate. Flowers Aug.–Dec.

Fruits: Shortly pedicellate, obconical, 0.4–1.2 × 1.2–0.9 cm (largest in *gratieae*); disc relatively broad, descending; valves (3)4(5), below rim level. Seeds flattened-ovoid to cuboid, brown, hilum ventral.

Wood: Heartwood yellow-brown to dark brown, very dense, hard, tough, with a closely interlocked grain; density about 990 kg m⁻³; used formerly for wheelwright and similar work, but now little is available in commercial size.

Climate: Altitudinal range: 30–350 m; Hottest/coldest months: 30–36°C/4–8°C; Frost incidence: low to moderate (up to 15 each year); Rainfall: 250–750 mm per year, winter max.

Distinctive features: A rough-barked tree (*loxophleba*, *supralaevis*) towards the west and north of its occurrence and a smooth-barked mallee to the east and south-east (*gratieae*, *lissophloia*); juvenile leaves bluish green; adult leaves glossy; inflorescences axillary; buds clavate; fruits obconical.



Eucalyptus loxophleba: subsp. *loxophleba* (l), subsp. *gratae* (g) 1. Bark (g) 2. Adult leaves 3. Intermediate leaves 4. Juvenile leaf 5. Bark (l) 6. Adult leaf venation 7. Seedling 8. Tree, near Northam, W.A. (l) 9. Mallee, east of Tammin, W.A. (g) 10. Buds 11. Fruits

Dundas Mahogany

Eucalyptus brockwayi C. Gardner

Dundas mahogany is a medium-sized tree up to 25 m in height and 0.7 m dbh. The trunk is moderately straight but commonly does not exceed one-third to half the tree height, above which it divides into several ascending branches, which carry an open but deep crown, with shining green foliage.

Dundas mahogany is restricted to a small area of the southern goldfields near Norseman in Western Australia, some 160 km south of Kalgoorlie. All known natural populations of this species occur within a 30 km radius of Norseman.

The area of occurrence consists of an extensive plain about 300 m in altitude, which includes a north and south ridge of basic rocks that constitute the auriferous belt. The species occurs most commonly on the small rocky hills where the soils are mainly gravelly sands or sandy loams derived from basic metamorphic rocks, including greenstone (metamorphosed basalt). It is also recorded from clayey flats and undulating terrain derived from laterite or granite.

Dundas mahogany grows in woodlands and may be associated with Goldfield's blackbutt (*E. lesouefii*), Dundas blackbutt (*E. dundasii*), merrit (*E. urna*) and coral gum (*E. torquata*).

Related species: Dundas mahogany is not closely related to any other species and was placed in the monotypic series *Brockwayanae* by Brooker (2000). In the field, it may resemble salmon gum (*E. salmonophloia*) and merrit (*E. urna*) but its characteristic buds and fruits readily distinguish it. The seedlings of Dundas mahogany are unique in the genus with their softly pubescent crowded leaves, arranged irregularly around the stem.

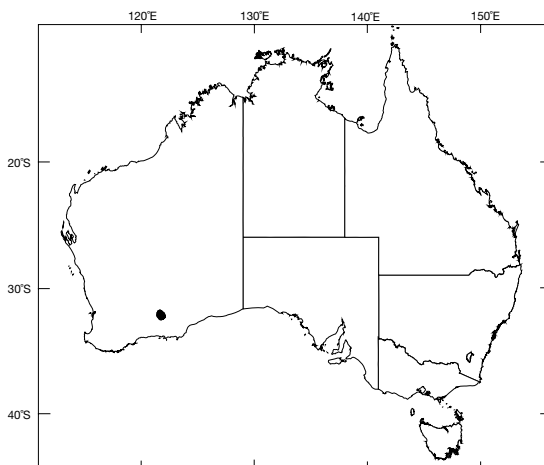
Publication: *J. Proc. Roy. Soc. W.A.* 27, 185 (1942). Type: Near Norseman, Western Australia, 15 Dec. 1940, G.E. Brockway and C.A. Gardner 5598.

Names: Botanical—after G.E. Brockway (1900–1973), formerly Divisional Forest Officer at Kalgoorlie, one of the collectors of the type specimen. Common—Dundas was an early mining town south of Norseman, and 'mahogany' probably refers to the reddish colour of the wood.

Bark: Shed in large patches from the whole of the trunk and branches, leaving the surface smooth and whitish or salmon pink; high in tannin (about 40 per cent).

Leaves: Seedling—alternate or opposite, sessile, crowded on the stem, linear to lanceolate, $1\text{--}2.7 \times 0.1\text{--}0.5$ cm, pale green, concolorous, pubescent. Juvenile—alternate or sometimes still more or less opposite, sessile, elliptical, $2\text{--}7 \times 0.5\text{--}3$ cm, pale green, concolorous. Intermediate—alternate, petiolate, lanceolate to narrow-lanceolate, $10\text{--}13 \times 1.4\text{--}3.3$ cm, glossy green, concolorous. Adult—alternate, petiolate, narrow-lanceolate, $7\text{--}13 \times 0.7\text{--}1.3$ cm, glossy green, concolorous.

Inflorescences: Simple, axillary, 7 to 15-flowered; peduncles angular, 0.3–1.4 cm long; pedicels 0.1–0.2 cm long, though sometimes absent; buds more or less ovoid, $0.7\text{--}0.8 \times 0.3\text{--}0.4$ cm; hypanthia globular to urceolate,



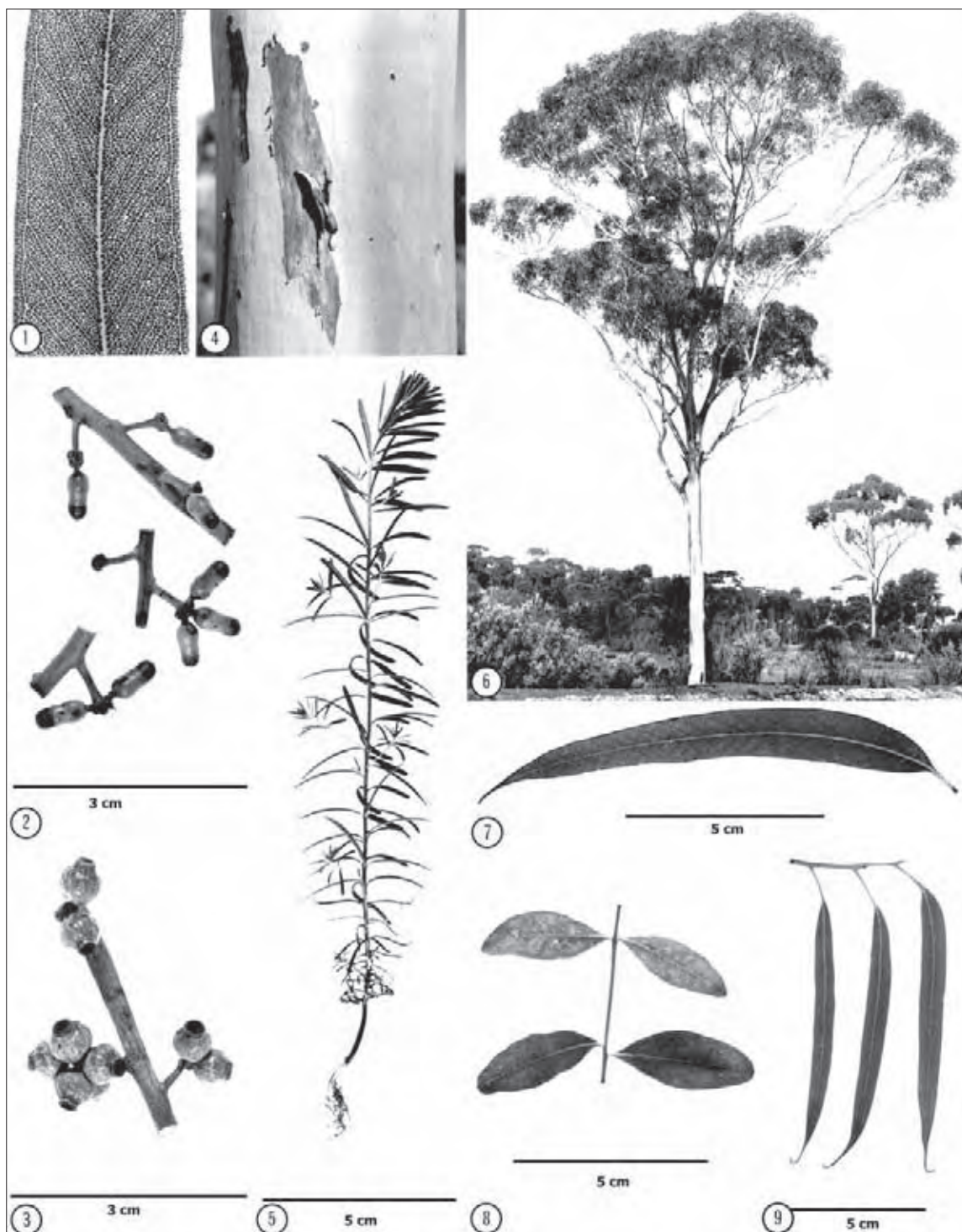
distinctly wider than the rounded-conical or hemispherical opercula. Flowers Mar.–Jun.

Fruits: Very shortly pedicellate or sessile, globular, $0.5\text{--}0.6 \times 0.4\text{--}0.6$ cm, contracting to a short neck, forming a very small orifice; disc broad, descending vertically; valves 3(4) enclosed, tips can sometimes be seen just below rim level. Seeds flattened-ovoid, grey, hilum ventral.

Wood: Heartwood red, straight-grained, long-fibred, hard and tough but not termite-resistant; green density is 1260 kg m^{-3} ; has been used for axe-handles, mining timber and firewood; recently used as head joints for flutes.

Climate: Altitudinal range: 200–430 m; Hottest/coldest months: $32^\circ\text{C}/5^\circ\text{C}$; Frost incidence: moderate (about 5–10 each winter); Rainfall: 250–300 mm per year, winter max.

Distinctive features: A non-lignotuberos eucalypt with smooth whitish or salmon-coloured bark; adult leaves rather small and shining green with oil glands obscure or absent; juvenile leaves linear, pubescent, crowded on the stem and quite unlike those of other eucalypts; buds widest at the base; fruits small, globular with a prominent neck, and with the valves enclosed.



Eucalyptus brockwayi 1. Adult leaf venation 2. Buds 3. Fruits 4. Bark 5. Seedling 6. Trees, south of Widgiemooltha, W.A. 7. Intermediate leaf 8. Juvenile leaves 9. Adult leaves

Redwood Boongul

Eucalyptus transcontinentalis Maiden

Redwood is either a tree up to 25 m tall with a dbh of 0.6 m, or a mallee only 6 m tall. Branching is usually ascending and the crown foliage usually dense. There are two subspecies, the typical smooth-barked form and the rough-barked subsp. *semivestita*.

Redwood is widespread in the northern wheat belt and the goldfields area of Western Australia. The typical form has its main occurrence in the goldfields, south from Marvel Loch and Bullfinch to the Salmon Gums region and from Hyden east to Karonie. Subsp. *semivestita* extends from Moora and Coorow in the northern wheat belt east to Menzies and south-east to Bruce Rock.

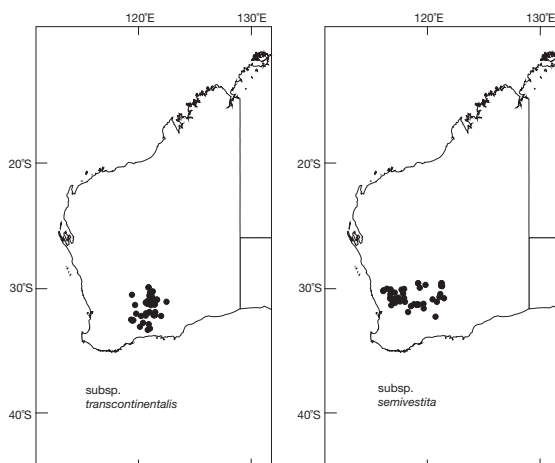
This species occurs on the extensive flat lands of the goldfields or on the lower slopes of broad valleys of the wheat belt. Subsp. *transcontinentalis* mainly grows on reddish clay loams, while subsp. *semivestita* on reddish-brown sandy loams or grey sands and sandy loams. Substrates include laterite, ironstone, limestone or sometimes sand dunes.

Both taxa occur in open eucalypt woodlands associated with a wide range of species, including salmon gum (*E. salmonophloia*), gimlet (*E. salubris*) and mirret (*E. celastroides*), sandplain mallee (*E. ebbanoensis*), red-flowered mallee (*E. erythronema*) and ribbon-barked gum (*E. sheathiana*).

Related species: Redwood belongs in the large series *Subulatae* (Brooker 2000), whose number of species has been greatly increased in recent years. Based mainly on seedling characters, this series was divided into four subseries with redwood placed in subseries *Decurrentes*, diagnosed by the decussate and unique decurrent seedling leaves. In the field, *Decurrentes* species are conspicuous by the coarse decurrent juvenile leaves, which are often seen as regrowth on roadsides. Redwood is most closely related to *E. optima*, which occurs east of Norseman, and shares the erect smooth-barked habit, but differs by the larger buds, which have an operculum wider than the hypanthium, and truncate-globose fruits, which have a level and more prominent rim. Merrit (*E. urna*) is also related to redwood but can be distinguished by the smaller mallet habit, the very glossy green adult leaves, and the broadly ribbed buds and fruits. The mallee form of redwood, which grows on sandy sites and formerly ascribed to this species, is now regarded as separate species, *E. luculenta* (Johnson and Hill 1999). Nicolle (2005) recognises the distinction between the non-lignotuberous *transcontinentalis*, and the lignotuberous mallee or tree, *semivestita*, but includes the latter under *E. moderata* Johnson & Hill.

Publication: Subsp. *transcontinentalis*: J. Proc. Roy. Soc. N.S.W. 53, 58 (1919). Type: Kalgoorlie, Western Australia, Sep. 1909, J.H. Maiden. Subsp. *semivestita* L.A.S. Johnson & K.D. Hill: *Telopea* 8, 201 (1999). Type: Noongar, 12 Nov. 1976, R. Coveny 8373 & B. Habersley.

Names: Botanical—Latin *trans* (across), *continentalis* (continental), refers to the early opinion that the species occurred right across southern Australia, *semivestitus* (half-clothed), referring to the basal rough bark. Common—refers to the heartwood colour.



Bark: In subsp. *transcontinentalis*, usually smooth throughout, white or grey; in *semivestita*, rough over part or most of the trunk or stems, dark grey to black, smooth white, grey, creamy brown to pale pink above.

Leaves: Seedling—opposite, sessile, lanceolate for a few pairs then ovate, strongly decurrent, 1.5–3 × 0.6–1.3 cm, bluish green, concolorous. Juvenile—alternate and petiolate or opposite, sessile and decurrent, ovate, 3–16 × 1.3–4.7 cm, bluish green, concolorous. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 8.5–15 × 2.2–3.7 cm, bluish grey or greyish green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 7–15 × 1–2.2 cm, dull, bluish grey or greyish green, concolorous.

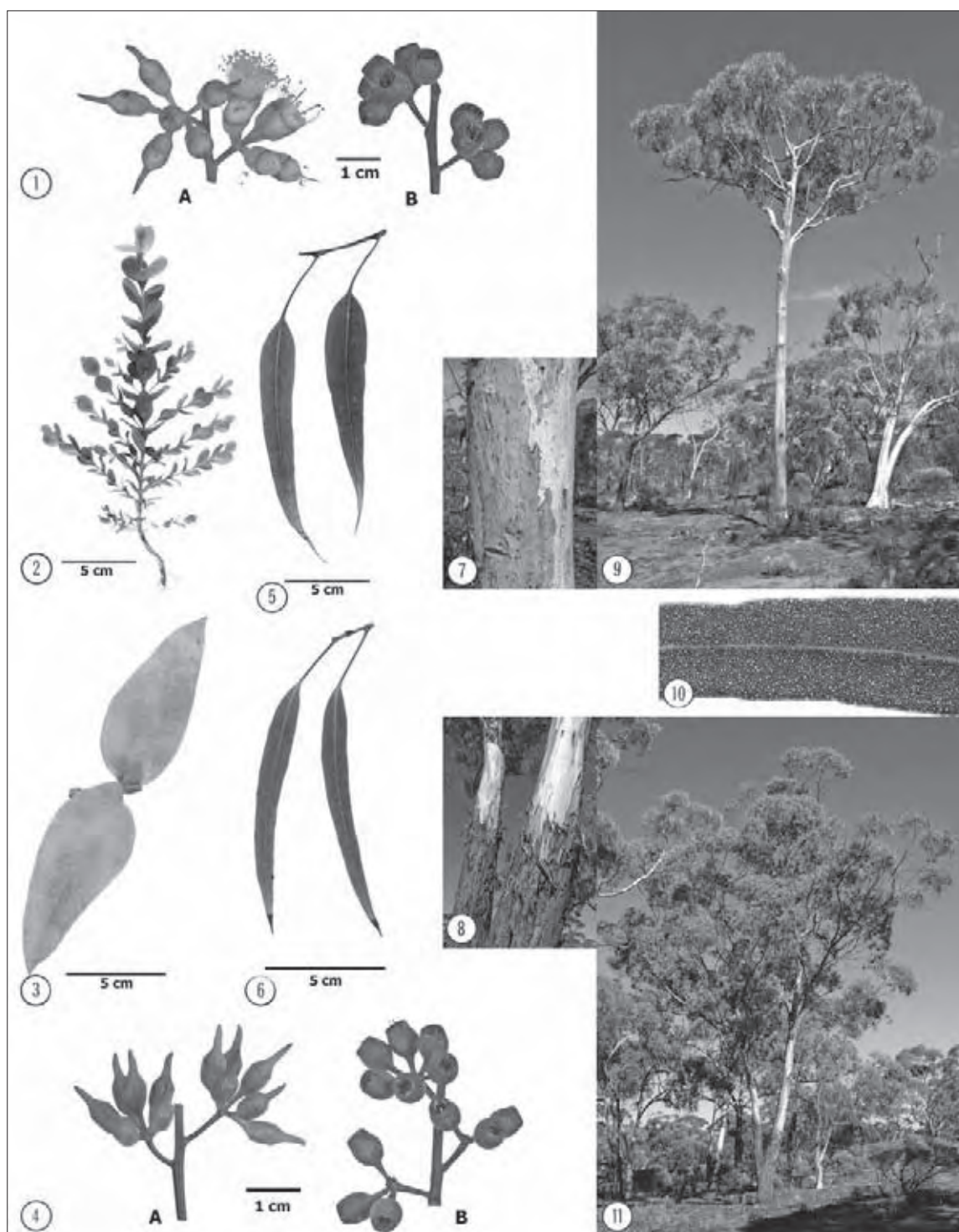
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles terete to slightly angled, 0.5–1.6 cm long; pedicels 0.4–0.7 cm long; hypanthia cylindrical to slightly pyriform; opercula strongly beaked, 1½–2½ times the length of the hypanthia; buds 1.4–2 × 0.4–0.6 cm, often pruinose; filaments yellow. Flowers Aug.–Oct.

Fruits: Pedicellate, ovoid, urceolate or subglobular, 0.6–1.1 × 0.6–1.1 cm; disc broad, descending; valves 3–5, sunken and often with conspicuous fragile style remnants attached, usually about rim level (though the style remnants often give a strongly exerted appearance); often pruinose. Seeds flattened-ovoid, shiny, grey, hilum ventral.

Wood: Heartwood red-brown, tough, hard, durable; density 1080 kg m⁻³; formerly used as firewood in the mining industry and by Aboriginal people for making spears; recently used as head joints for flutes, flooring, panelling and furniture.

Climate: Altitudinal range: 150–350 m; Hottest/coldest months: 27–35°C/4–6°C; Frost incidence: low to moderate (up to about 10 each year); Rainfall: 250–500 mm per year, mainly winter max.

Distinctive features: A tree with smooth, white bark (*transcontinentalis*) or straggly tree or mallee with rough bark over part or most of the trunk or stems (*semivestita*); branchlets pruinose; leaves dull; opercula strongly beaked; buds and fruits smooth and often pruinose; flowers yellow; juvenile leaves decurrent. Typical redwood is non-lignotuberous.



Eucalyptus transcontinentalis: subsp. *transcontinentalis* (t), subsp. *semivestita* (s) 1. A—buds, B—fruit (t) 2. Seedling 3. Juvenile leaves 4. A—buds, B—fruits (s) 5. Intermediate leaves 6. Adult leaves 7. Bark (t) 8. Bark (s) 9. Tree, Hunt Range, W.A. (t) 10. Adult leaf venation 11. Tree, near Koolyanobbing, W.A. (s)

Salmon Gum

Eucalyptus salmonophloia F. Muell.

Salmon gum is one of the larger and more beautiful trees of dryland south-west Western Australia. Commonly it is 15–20 m in height and up to 0.6 m dbh. Under the most favourable conditions it may attain 30 m in height and 1 m dbh. The trunk is usually about one-third of the tree height, and the crown is large, umbrageous, with the foliage consisting of very glossy green leaves clumped towards the extremities of the canopy. It is one of the best known trees of Western Australia because of its stature, brilliant coppery smooth bark in season, and crown of glossy green adult leaves.

Salmon gum occurs throughout the wheat belt and the eastern goldfield areas of Western Australia. It occurs from the eastern Darling Range at York and Northam, east to Cundeelee east of Kalgoorlie. Numerous remnant stands occur in the wheat belt, an area from which it has been extensively cleared in the development of arable land.

This species grows on gentle lower slopes and broad diffuse valleys, in a landscape of uniformly low relief. Substrates are derived mainly from granite and gneiss. Soils are usually arable red, brown or grey loams but also include sandy loams to rather heavy clays. The subsoil usually has lime nodules in the upper layers and may be saline in the lower stratum.

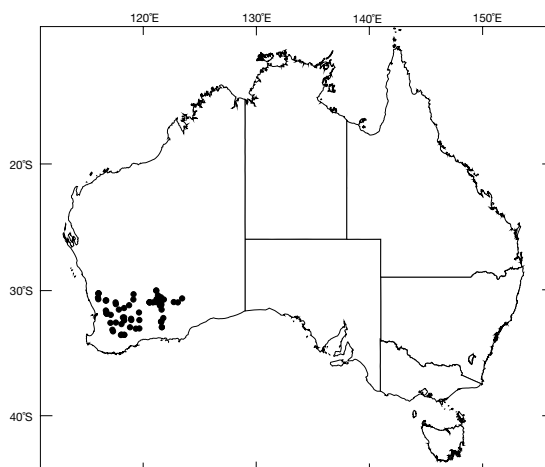
Salmon gum grows in open eucalypt forests and woodlands, associated with numerous species such as gimlet (*E. salubris*), red morrell (*E. longicornis*), York gum (*E. loxophleba*), silver-topped gimlet (*E. campaspe*) and redwood (*E. transcontinentalis*).

Related species: Salmon gum belongs in the monotypic series *Salmonophloiae* (Brooker 2000), as it does not have any closely related species. Superficially, it is likely to be confused with gimlet (*E. salubris*) another completely smooth-barked tree of the wheat belt and goldfields but which has prominent fluting of the trunk and quite different buds and fruits. Another species with a similar habit and bark is the salt gum (*E. salicola*), which is restricted to saline situations and belongs to another series, *Porantherae*. It is easily distinguished in the field by the presence of roundish, pruinose juvenile leaves, ovoid to fusiform buds and by the adnate anthers, diagnostic of its series.

Publication: *Fragm.* 11, 11 (1878). Types: Maiden (1914) interpreted the type citation from Mueller's protologue as 'from woods towards the mouth of the Swan River (F. von Muell.) from hence to the vicinity of Victoria Spring (C. Giles)' and cited in Chippendale (1988) as having a number of syntypes, viz. Upper Swan R., W.A., Nov. 1877, F. von Mueller; near York, W.A., Nov. 1887, F. von Mueller; beyond York, W.A., Nov. 1887, F. von Mueller.

Names: Botanical—Latin *salmoneus* (salmon-coloured), Greek *phloios* (bark). Common—also refers to the bark colour.

Bark: Shed seasonally, though not all at once, in large patches or flakes to leave a smooth, satiny surface, at first bright, coppery or salmon-coloured, finally weathering to greyish.



Leaves: Seedling—opposite for a few pairs then alternate, shortly petiolate, elliptical to ovate, 2.5–8 × 1–2.2 cm, greyish green, concolorous. Juvenile—alternate, petiolate, ovate to lanceolate, 7–9 × 1.2–3 cm, greyish green, concolorous. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 8.5–12.5 × 1.6–3.2 cm, glossy green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 5.5–11 × 0.6–1.4 cm, glossy green, concolorous.

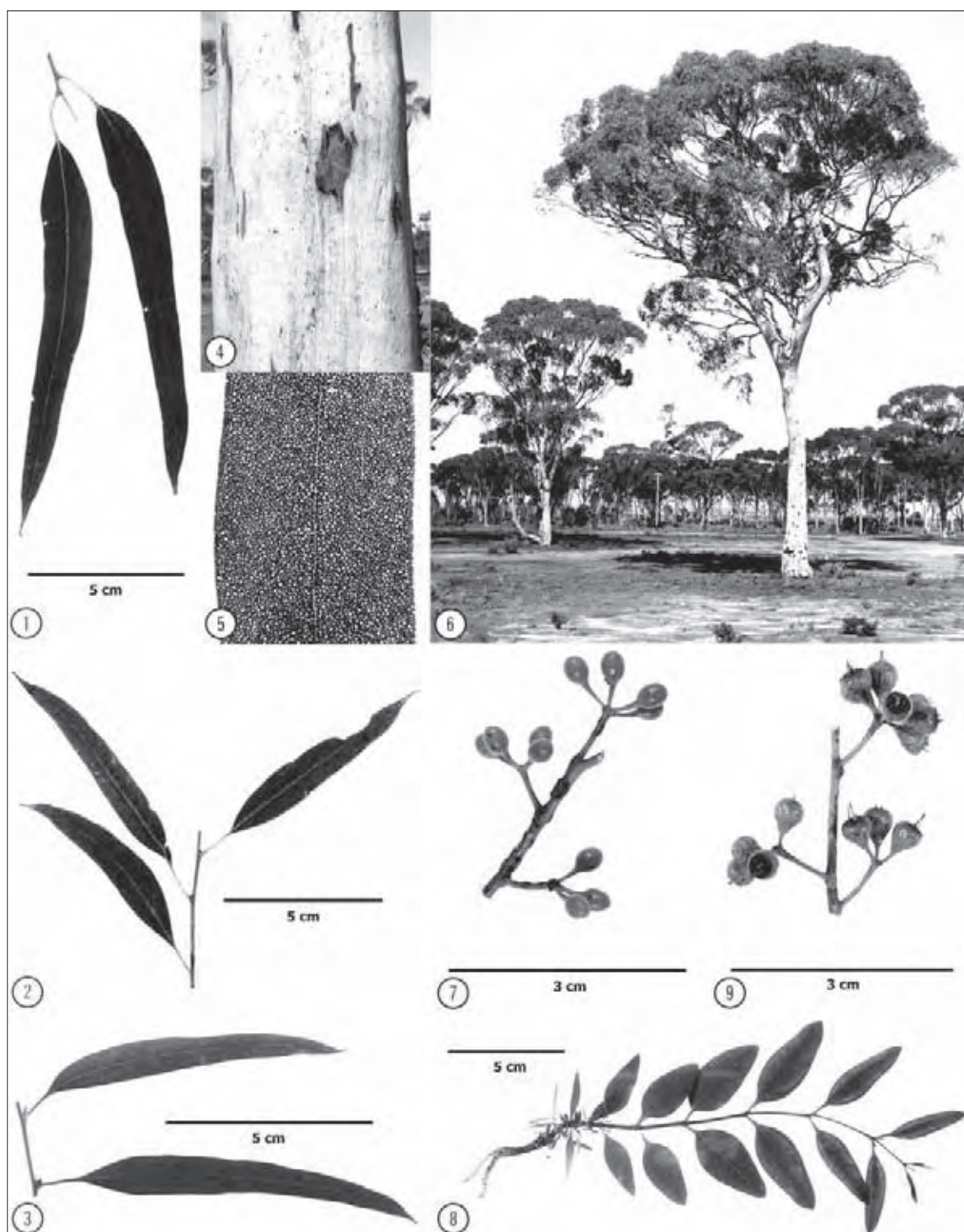
Inflorescences: Simple, axillary, 7 to 13-flowered; peduncles slender, terete to slightly angled, 0.5–1.4 cm long; pedicels 0.2–0.5 cm long; buds ovoid to almost globular, 0.3–0.7 × 0.3–0.4 cm; opercula hemispherical, hemispherical and apiculate or rounded-conical. Flowers Dec.–Mar.

Fruits: Pedicellate, more or less hemispherical, 0.3–0.5 × 0.3–0.5 cm, disc narrow, more or less level to descending; valves usually 3, broad-based (compared with other *Subulatae* species), erect, exserted, often with style remnants attached. Seeds flattened-ovoid, grey, hilum ventral.

Wood: Heartwood red to red-brown, straight-grained to mostly interlocked, fine-textured, with attractive appearance on quartersawn surfaces, very strong, fairly durable; resistant to termites and *Lyctus*; density about 1040 kg m⁻³; once used extensively for round and sawn mining timber, firewood and second-class railway sleepers. Recent uses include flooring, panelling, flute head joints and furniture.

Climate: Altitudinal range: 150–400 m; Hottest/coldest months: 30–36°C/4–7°C; Frost incidence: low to moderate (up to about 10 each year); Rainfall: 250–500 mm per year, winter max.

Distinctive features: A non-lignotuberos eucalypt, remarkably tall in low rainfall areas such as the goldfields and the Great Victoria Desert, with smooth, satiny, coppery or salmon-coloured bark when newly exposed; foliage often confined to extremities of the canopy; leaves bright, glossy green; buds small, ovoid to globular; fruits small, hemispherical with slender, exserted valves.



Eucalyptus salmonophloia 1. Intermediate leaves 2. Adult leaves 3. Juvenile leaves 4. Bark 5. Adult leaf venation 6. Stand, east of Tammin, W.A. 7. Buds 8. Seedling 9. Fruits

White Mallee

Eucalyptus dumosa Cunn. ex Oxley

This species is typically a mallee, usually in the height range 2–10 m, but occasionally it grows as a small tree up to 12 m in height—its better development being a response to more favourable conditions of soil and rainfall.

White mallee extends east–west for about 900 km in south-eastern Australia. In New South Wales the occurrence is in the south-western quarter, and in South Australia it extends east of Spencer Gulf from the Flinders Ranges to the Upper South East (Murray Bridge to Bordertown). It is also abundant in north-western Victoria. Populations of white mallee from northern Eyre Peninsula warrant further study to assess if their difference in leaf colour merits taxonomic recognition.

A large part of the occurrence is on the plains and very gentle slopes of the Murray River Basin. It is common on calcareous and sodic soils and scattered areas of desert loams and skeletal types and less often on grey and brown soils of heavy texture.

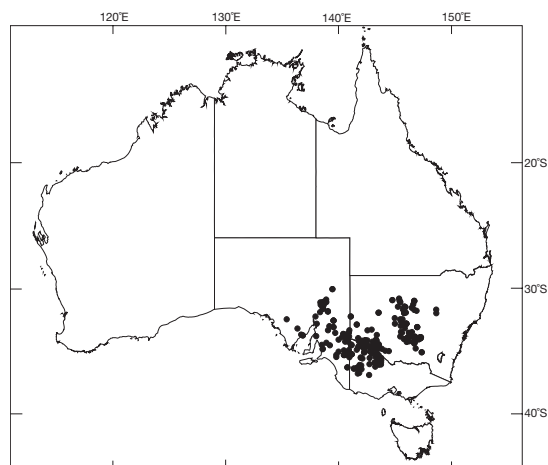
White mallee is found in tall, open or closed shrublands and in many areas the stands attain high density. It grows in association with numerous other mallee species (e.g. *E. socialis*, *E. oleosa*, *E. incrassata*, *E. gracilis*, *E. leptophylla*, *E. calycogona*, *E. polybractea*, *E. viridis* and *E. behriana*) and in some areas there may be the scattered trees of gum-topped coolibah (*E. intertexta*), bimbil box (*E. populnea*) and red ironbark (*E. sideroxylon*).

Related species: Brooker (2000) followed Pryor and Johnson (1971) and placed white mallee in the large section *Dumaria*. Of the 11 series in this section, white mallee belongs in the *Rufispermae*, a series of about 25 species diagnosed by the flattish, lustrous, red seeds. The series is divided roughly into two groups recognised by the dull or glossy adult leaves. White mallee may be somewhat anomalous in this respect, as the mature adult leaves of the current crop are dull but often become slightly glossy by the second year inside the crown. Extreme grey, dull-leaved forms occur in the Mallee Cliffs region north-east of Mildura. White mallee was once confused with blue-leaved mallee (*E. cyanophylla*) of the northern mallee region of South Australia and north-western Victoria, but this species has larger, dull, greyish adult leaves, larger buds and fruits, is spring flowering and occupies slightly higher ground. Most confusion is with *E. phenax*, which occurs from Western Australia to north-western Victoria. The two species are very closely related, with *E. phenax* having regularly glossy leaves and has more or less sessile buds and fruits. Both are distinguished from the more coastal Port Lincoln mallee (*E. conglobata*), which has closely sessile buds and fruits. Nineteen new taxa were recognised in section *Dumaria* by Hill *et al.* (2001).

Publication: *J. Two Exped. Int. New South Wales* 63 (1820). Type: Euryalean Scrub, New South Wales, 23 May 1817, A. Cunningham 206.

Names: Botanical—Latin *dumosus* (of bushy habit). Common—refers to the whitish, newly exposed bark.

Bark: Decortivating in ribbons from the upper parts of the stems and branches to leave a smooth, white to yellow-white surface which gradually weathers to light grey. The persistent



bark at the base of the main stems is subfibrous and somewhat flaky.

Leaves: Seedling—opposite for 3 or 4 pairs then alternate, petiolate, ovate, 6–10 × 2.7–4.4 cm, greyish green, slightly discolorous. Juvenile—alternate, petiolate, ovate, 10–14 × 4–6 cm, greyish green, concolorous. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 8.5–14 × 2–4 cm, dull greyish green, concolorous. Adult—alternate, petiolate, lanceolate, 7–10 × 1–2 cm, dull greyish green, often maturing slightly glossy by the second year, concolorous.

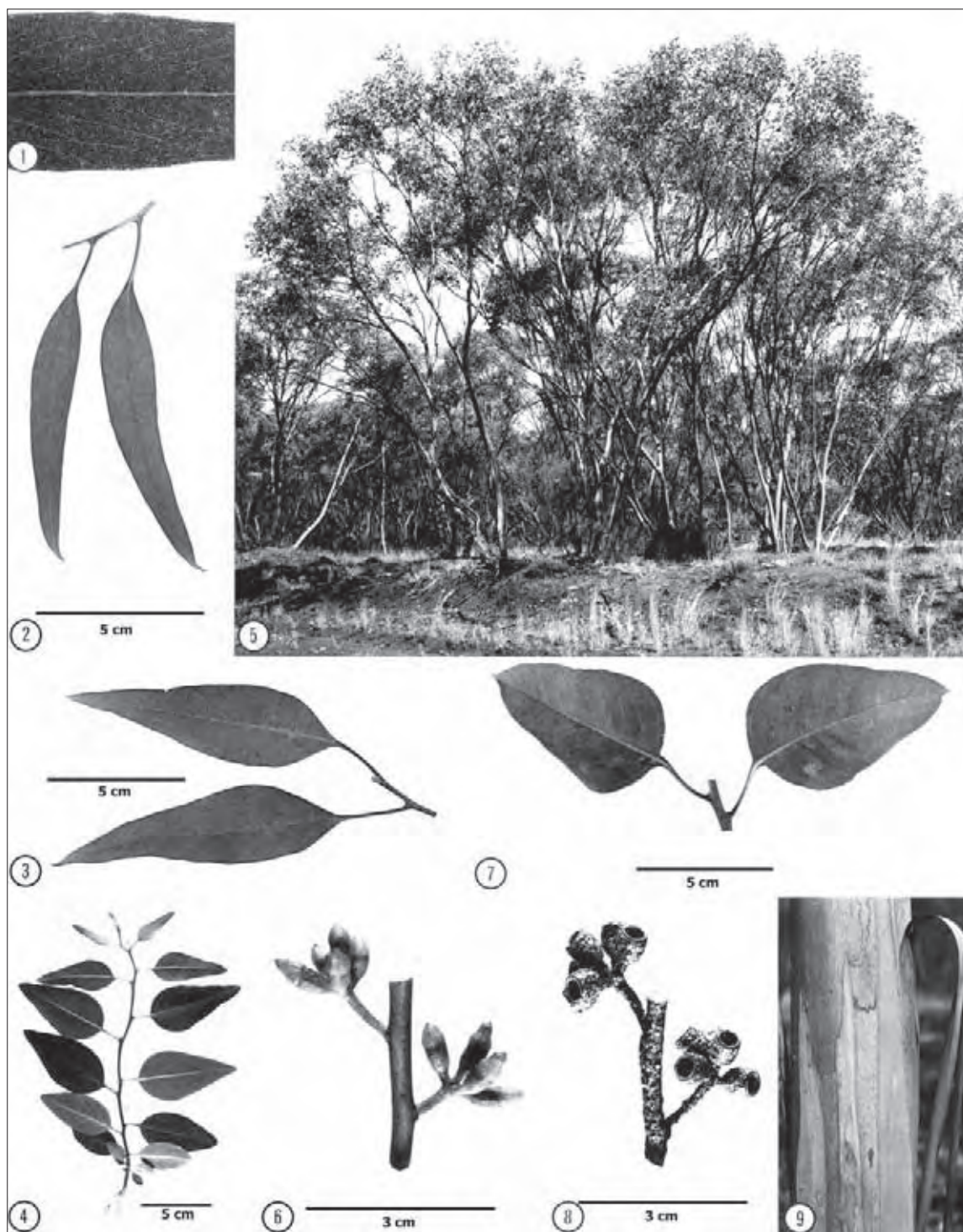
Inflorescences: Simple, axillary, 7-flowered; peduncles terete or slightly angular, 0.7–1.6 cm long; pedicels 0.1–0.5 cm long or occasionally absent; hypanthia more or less cylindrical, often faintly striated; opercula conical to hemispherical and apiculate or occasionally somewhat rostrate, faintly or conspicuously striated; buds 0.6–1 × 0.3–0.8 cm. Flowers Jan.–Apr.

Fruits: Shortly pedicellate or sometimes sessile, more or less cylindrical, often faintly striated, 0.5–0.9 × 0.5–0.8 cm; disc narrow to medium width, more or less level to descending; valves (3)4, erect, varying from slightly below rim level to slightly exserted. Seeds irregularly ovoid or flattened-ovoid, lustrous ruby-red to red-brown, hilum ventral.

Wood: Heartwood hard, moderately durable; density about 1050 kg m⁻³; only available in small sizes, useful for firewood, especially the lignotuber ('mallee root').

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 28–33°C/2–7°C; Frost incidence: low to moderate (about 15 each year in some areas); Rainfall: 250–500 mm per year, winter max. to uniform.

Distinctive features: A mallee with dull, greyish green leaves; pith of branchlets glandular; buds in 7s; hypanthia cylindrical; opercula usually ribbed; seed lustrous, red. It is the easternmost species of its taxonomic series.



Eucalyptus dumosa 1. Adult leaf venation 2. Adult leaves 3. Intermediate leaves 4. Seedling 5. Mallees, near West Wyalong, N.S.W. 6. Buds 7. Juvenile leaves 8. Fruits 9. Bark

Gungurru Gungunnu, Lemon-flowered Gum

Eucalyptus woodwardii Maiden

Gungurru is a small mallet to 10 m tall and dbh up to 40 cm. The tree is often of poor form in its original stands with a leaning trunk that branches at about half the tree height to form a crown of dull grey to grey-green leaves. The branchlets are usually pendulous and often hang to ground level.

This species has a restricted natural distribution in Western Australia but is locally common east of Kalgoorlie in the Karonie–Cundeelee area or southern part of the Great Victoria Desert.

Gungurru forms low woodlands on flats or gently undulating terrain and on reddish sandy or sandy loam soils. It typically forms small pure stands but Karonie redwood (*E. hypolaena*), yorrel (*E. gracilis*) or Strickland's gum (*E. stricklandii*) may occur in the vicinity.

Gungurru is widely used as a street and park tree in towns and cities of southern Australia because of its large, brilliant yellow flowers. When planted near the pink-flowered *E. torquata* the two frequently hybridise. The hybrids are informally known as *E.* 'Torwood'.

Related species: Gungurru belongs to a large group of species in section *Dumaria*, which is divided into many series (Brooker 2000). Gungurru is one of many species in the series *Rufispermae*, which is diagnosed by the lustrous, red seed type that is unique in the eucalypts. Conspicuous ribboning of the partly shed bark is another characteristic of the series.

Gungurru should not be confused with any other species in the series, although it shares the completely smooth bark of other large-fruited species, e.g. *E. pterocarpa* which differs in the glossy green leaves and strongly ribbed buds and fruit, and *E. georgei*, which has hemispherical opercula, smaller, more cupular fruits and creamy white flowers.

Publication: *J. W. Australian Natural History Society* 3: 42 (1910). Type: 120 miles east of Kalgoorlie, Western Australia, May 1909, H. Deane.

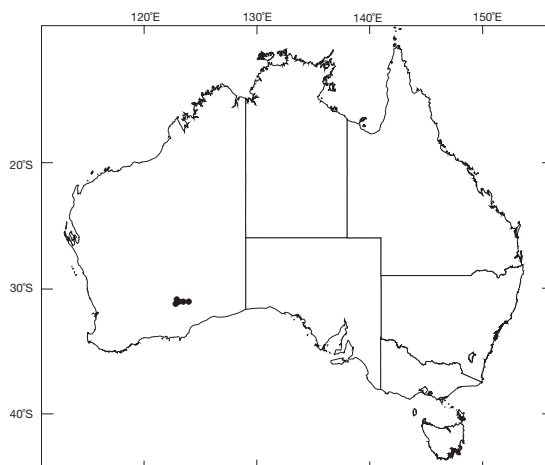
Names: Botanical—in honour of Bernard Henry Woodward (1846–1917), Director of the Western Australian Museum and Art Gallery. Common—of Aboriginal origin—see Rye and Hopper (1982) for discussion regarding the erroneous application of this name to *E. caesia*.

Bark: Smooth over whole trunk, shedding in long strips that persist hanging in the crown, newly exposed bark whitish weathering to salmon-coloured or pink.

Leaves: Seedling—opposite for 4–6 pairs, then alternate, petiolate, ovate, 6.5–10 × 2.5–5 cm, dull, greyish green. Juvenile—alternate, petiolate, ovate to broad-lanceolate to elliptical, 8–18 × 4–9 cm, dull, grey to grey-green. Adult—alternate, petiolate, broad-lanceolate, 10–18 × 2–5 cm, dull, grey-green to bluish green, concolorous.

Inflorescences: Simple, axillary, 7-flowered; peduncles stout, terete, 0.8–3 cm long; pedicellate; buds somewhat pyriform with obconical to campanulate hypanthia, 1.6–1.7 × 0.9–1 cm; opercula strongly beaked. Flowers Aug.–Nov.

Fruits: Pedicellate, cupular to obconical to slightly campanulate, 1.1–1.5 × 1.1–1.4 cm; disc descending; valves

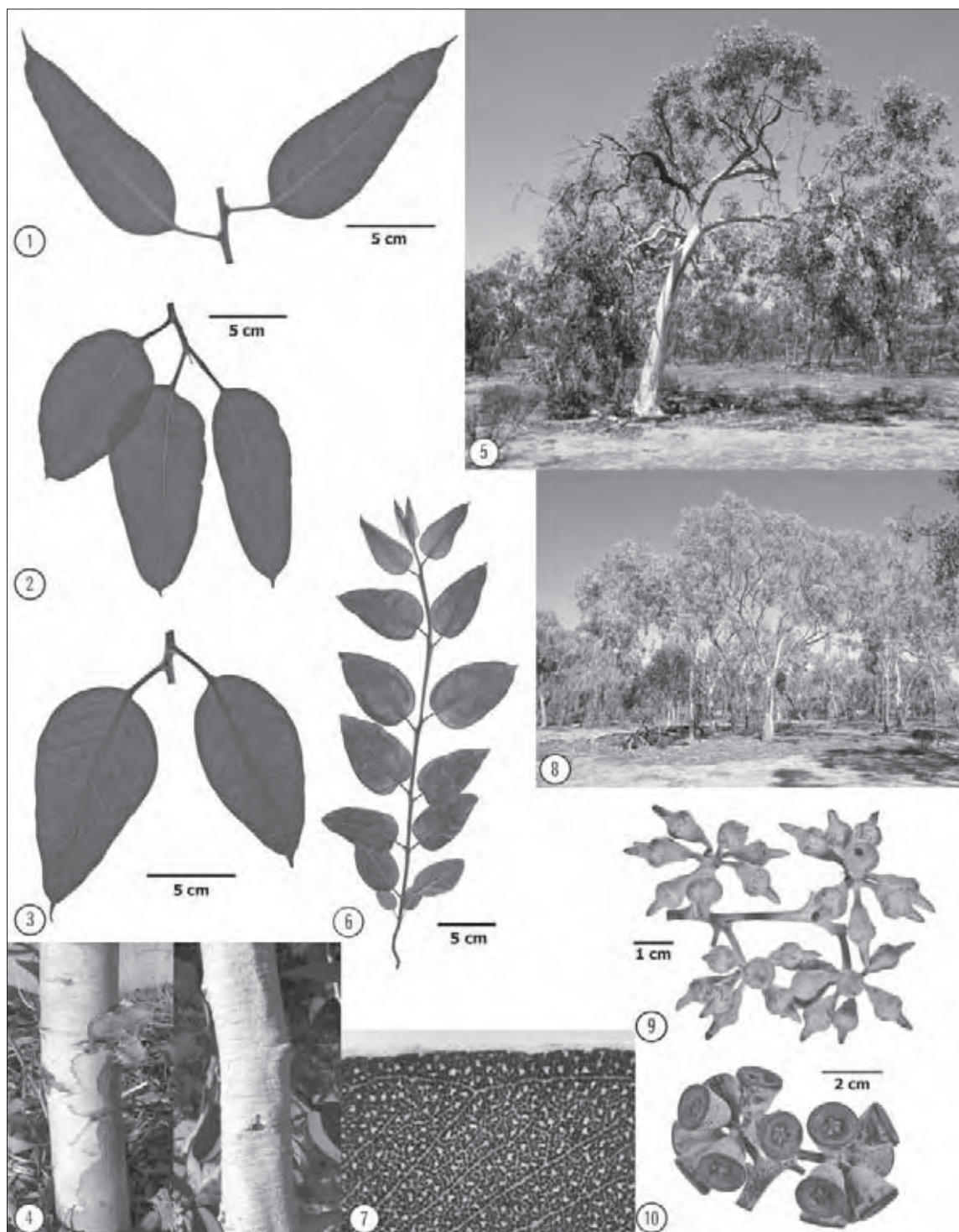


4 or 5, to rim level. Seeds flattish, lustrous ruby-red to red-brown, hilum ventral.

Wood: Poorly known due to rarity of natural populations; density 1160 kg m⁻³.

Climate: Altitudinal range: 340–380 m; Hottest/coldest months: 31–33°C/4–5°C; Frost incidence: moderate (about 10 each year); Rainfall: 220–250 mm per year, uniform.

Distinctive features: Small non-lignotuberos mallet with smooth bark over whole trunk, with conspicuous ribboning of partly shed strips of bark; crown of dull, greyish leaves, often with branchlets hanging to the ground; brilliant yellow flowers.



Eucalyptus woodwardii 1. Adult leaves 2. Intermediate leaves 3. Juvenile leaves 4. Lower (left) and upper (right) bark of a cultivated sapling 5, 8. Trees, near Cundeelee, W.A. 6. Seedling 7. Adult leaf venation 9. Buds 10. Fruits

Goldfield's Blackbutt

Eucalyptus lesouefii Maiden

Goldfield's blackbutt is a small tree to 15 m tall and with a dbh to 50 cm. The trunk usually branches at less than half tree height to form a crown of glossy green leaves. From a distance the crown may appear grey-green, while in the northern part of the distribution the leaves are duller. The black basal stocking of bark, which is part of its common name, is conspicuous and distinctive in the field.

This species is widespread in the central and southern goldfields of Western Australia. It extends from about Leonora and Lake Minigwal in the north, towards Cundeelee in the east, south to the Norseman area and east to the Fraser Range.

Goldfield's blackbutt grows on several soil types including sandy or powdery loam, alluvial areas with gravel, calcareous loam, clay loam, or skeletal clay, on flat country or on low rises. Rock substrates include porphyry, greenstone and limestone.

This species grows in open woodland. Typical of species endemic to the Goldfields region of Western Australia, it may occur with a wide range of other eucalypts including redwood (*E. transcontinentalis*), red morrell (*E. longicornis*), Dundas blackbutt (*E. dundasii*), Dundas mahogany (*E. brockwayi*), salmon gum (*E. salmonophloia*), coral gum (*E. torquata*), and *E. griffithsii*. *Acacia* species include *A. tetragonophylla* and *A. acuminata*.

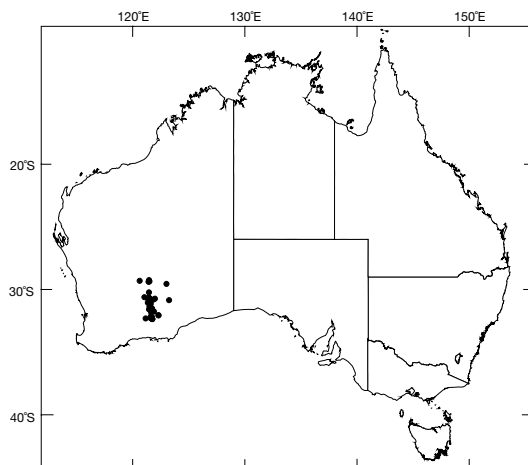
Related species: Goldfield's blackbutt belongs to a large group of species in series *Rufispermae*, one of the many series in section *Dumaria* (Brooker 2000). It is difficult to further divide the series into related groups. Series *Rufispermae* is diagnosed by the lustrous, red seed type that is unique in the eucalypts. Conspicuous ribboning of the partly shed bark is another characteristic of the series. Goldfield's blackbutt has relatively large glossy green leaves (for most of its distribution) which distinguishes it from another goldfields blackbutt, Cleland's blackbutt (*E. clelandii*), which may overlap in distribution but occurs also near Mt Gibson to the north-west. Cleland's blackbutt is usually a smaller tree with smaller, dull, blue-green to grey-green leaves. Its buds and fruits are smaller and only the operculum is ribbed, contrasting with the larger, strongly ribbed buds and fruits of Goldfield's blackbutt. The other species in the series which may occur nearby with strongly ribbed buds and fruits is *E. pterocarpa* which has bright green glossy leaves and is completely non-pruinose.

Publication: *Crit. Revis. Eucalyptus* 2, 187 (1912). Type: Kalgoorlie, Western Australia, Sep. 1909, J.H. Maiden.

Names: After Ernest Le Souef (1869–1937), ornithologist and foundation Director of the Zoological Gardens, Perth. Common—refers to the dark, rough basal bark.

Bark: Very thick, rough at base, black, smooth, whitish grey to pinkish grey above, often powdery.

Leaves: Seedling—alternate, petiolate, ovate, 5–9 × 2.5–5 cm, grey-green. Juvenile—alternate, petiolate, ovate, 9–16 × 4.5–8 cm, dull, grey-green, pruinose. Adult—alternate, petiolate, lanceolate, 6–18 × 1–2.3 cm, glossy, green, concolorous.



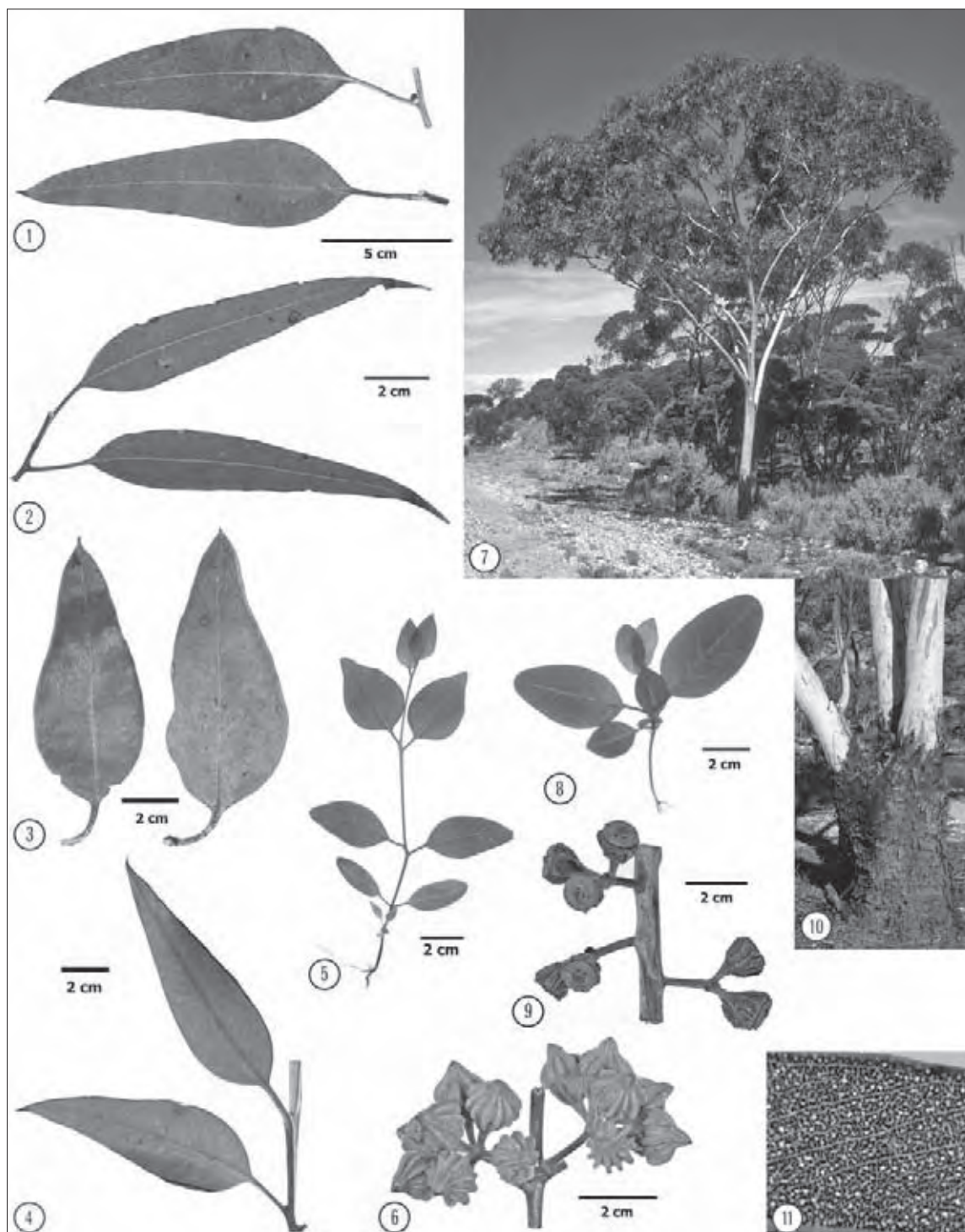
Inflorescence: Simple, axillary, 7 or 9-flowered; peduncles terete or angular, 0.5–1.6 cm long; buds pedicellate; double-conic, ribbed all over, 1.2–2 × 0.7–1.4 cm, often pruinose; opercula conical to beaked. Flowers Nov.–Feb.

Fruits: Pedicellate, obconical to slightly campanulate, strongly ribbed, 0.7–1.1 × 0.8–1.2 cm, often pruinose; rim thick, disc annular then descending, valves 4 or 5 to rim level. Seeds flattened-ovoid, lustrous ruby red, hilum ventral.

Wood: Heartwood dark brown with an attractive grain, durable with good workability characteristics, density around 1130 kg m⁻³; in the past it was used for mining timber and for firewood, currently sought after for furniture, craftwood and has potential as flooring timber but availability is limited.

Climate: Altitudinal range: 200–400 m; Hottest/coldest months: 31–33°C/4–5°C; Frost incidence: moderate (about 5–10 each year); Rainfall: 230–300 mm per year, mainly winter max.

Distinctive features: A small non-lignotuberous tree with black, rough basal bark; branchlets, buds and fruit usually pruinose, pith of branchlets glandular; adult leaves glossy green; buds and fruits strongly ribbed.



Eucalyptus lesouefii 1. Intermediate leaves 2. Adult leaves 3. Coppice leaves 4. Juvenile leaves 5. Seedling 6. Buds 7. Tree, near Norseman, W.A. 8. Young seedling 9. Fruits 10. Bark 11. Adult leaf venation

Coral Gum Coolgardie gum, Pink-flowered Gum, Goldfield's Red-flowering Gum

Eucalyptus torquata Luehm.

Coral gum is a small tree rarely greater than 10 m tall or with a dbh rarely greater than 35 cm. The trunk usually branches at less than half tree height to form a crown of dull, grey to grey-green leaves.

Coral gum is restricted to the central and southern goldfields of Western Australia, from Coolgardie to east of Kalgoorlie and south to Norseman.

It occurs naturally in skeletal red-brown sands or loams on rocky hillsides derived from schist or greenstone (metamorphosed basalt).

Coral gum grows in woodlands rich in endemic eucalypts. While numerous species may be present it is most commonly associated with salmon gum (*E. salmonophloia*), mirret (*E. celastroides*), Goldfield's blackbutt (*E. lesouefii*), *E. griffithsii*, sheoak (*Allocasuarina helmsii*) and emu bushes (*Eremophila* spp.).

This species is widely cultivated as a street tree in towns and cities of southern Australia because of its adaptability, colourful pink flowers and ornamental buds and fruits. Hybrids between coral gum and gun-gurru (*E. woodwardii*), result when the two are cultivated in close proximity. The hybrids are known informally as *E.* 'Torwood'.

Related species: Brooker (2000) placed coral gum in a large group of species in section *Dumaria*, which is divided into 11 series. Coral gum is isolated in the section and is the single species that constitutes series *Torquatae*, diagnosed by the flattened grey-black, shallowly pitted, non-toothed seeds. The series of section *Dumaria* are diagnosed by the seed characters. Externally, coral gum is easily recognised by the hard rough bark, dull leaves, ornamented buds and fruits, and often pink or red flowers. The degree of ornamentation of the buds is unique in the section.

Publication: *Victorian Naturalist* 13, 147 (1897). Type: near Coolgardie, Western Australia, W.A. Macpherson.

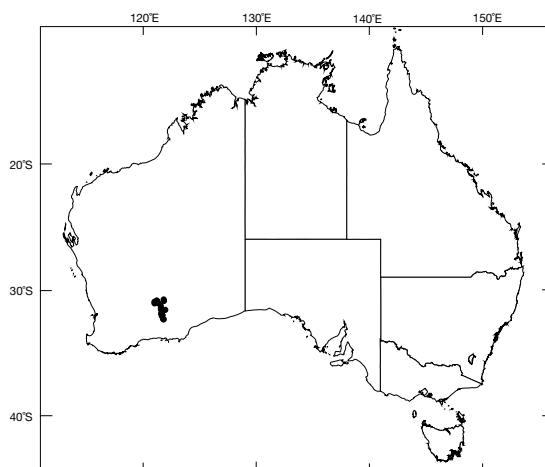
Names: Botanical—Latin *torquatus* (adorned with a collar), referring to the ornamentation of the buds. Common—referring to the colour of the flowers.

Bark: Rough, hard throughout, shortly fissured to slightly tessellated, grey-brown to grey-black.

Leaves: Seedling—opposite for 3 or 4 pairs, then alternate, petiolate, lanceolate, 4.5–9 × 1.2–2.5 cm, dull, green. Juvenile—alternate, petiolate, elliptical to lanceolate, 4.5–12 × 1.2–3 cm, dull, grey-green. Adult—alternate, petiolate, lanceolate, 6–15 × 1–2.5 cm, dull, light green when newly formed, maturing to grey-green, concolorous.

Inflorescences: Simple, axillary, 7-flowered; peduncles down-curved, terete, 1.5–3.5 cm long; pedicellate; buds with cylindrical base ribbed at the abrupt top of the pedicel, 1.4–3 × 0.7–1.1 cm; opercula strongly beaked with a prominent ribbed flange encircling the base. Flowers Aug.–Nov.

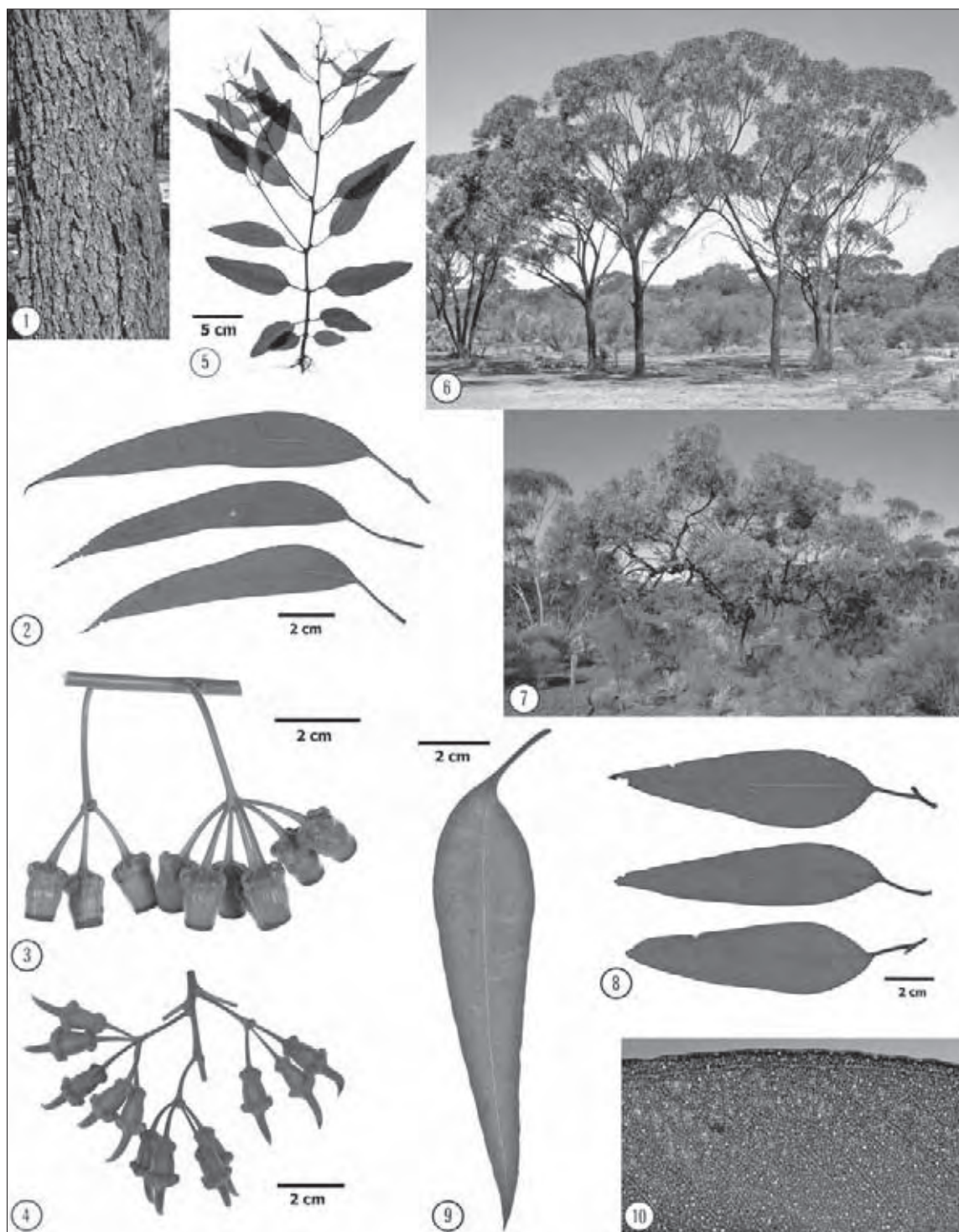
Fruits: Pedicellate, cylindrical with ribbed base, 1.2–1.7 × 0.7–1.2 cm; rim moderately thick, disc descending; valves 4(5), to rim level or enclosed. Seeds flattened-ovoid, grey, deeply pitted, hilum ventral.



Wood: Heartwood pale brown, straight-grained; density 1090 kg m⁻³; no known uses apart from firewood.

Climate: Altitudinal range: 250–500 m; Hottest/coldest months: 31–33°C/4–5°C; Frost incidence: moderate (about 10 each year); Rainfall: 230–300 mm per year, slight winter max.

Distinctive features: Small tree with hard rough bark over whole trunk; crown of dull, light green to grey-green leaves; highly ornamented, ribbed buds; white, pink or red flowers.



Eucalyptus torquata 1. Bark 2. Adult leaves 3. Fruits 4. Buds 5. Seedling 6. Stand, near Kambalda, W.A. 7. Tree, near Widgemooltha, W.A. 8. Intermediate leaves 9. Juvenile leaf 10. Adult leaf venation

Dundas Blackbutt

Eucalyptus dundasii Maiden

Dundas blackbutt is a tree attaining up to 20 m in height and with a dbh of 0.7 m. The bole is usually short, rarely exceeding one-third of the tree height. The crown is somewhat lightly branched, with the foliage tending to be clumped at the ends of the branches.

This species has a limited natural occurrence, mainly around Norseman, Western Australia, extending about 100 km to the west and east of the town towards the Fraser Range. It is plentiful south of Norseman in the vicinity of Lake Dundas. A smaller disjunct occurrence is near Callion, north of Coolgardie.

This species typically occurs on an extensive plain with only small isolated occurrences on rises and low hills. It grows on the better portions of the plains and prefers loamy soils, particularly red gravelly loams and calcareous soils.

Dundas blackbutt is a species of open forests and woodlands. It may occur in pure stands on alluvial soil such as the occurrence near Lake Dundas, but elsewhere it is scattered with salmon gum (*E. salmonophloia*), Dundas mahogany (*E. brockwayi*), Goldfield's blackbutt (*E. lesouefii*), black morrell (*E. melanoxylon*) and merritt (*E. urna*).

Related species: Dundas blackbutt is placed in its own monotypic series (*Dundasianae*), as it is not closely related to any other species in section *Bisectae* (Brooker 2000). With its basal, compact, tessellated bark, shiny green apparently glandless leaves and subsessile, cylindrical fruits, it should not be confused with any other species.

Publication: J. & *Proc. Roy. Soc. N.S.W.* 49, 309 (1915). Type: Dundas, Western Australia, Oct. 1901, L. Diels 5454.

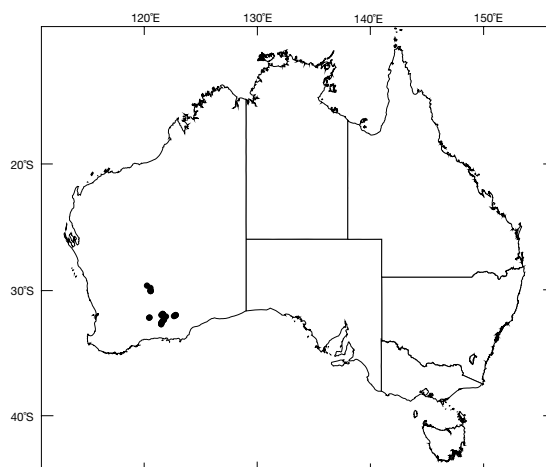
Names: Botanical—after the town of Dundas, a former mining town south of Norseman. Common—refers to the Dundas locality and to the dark-coloured, rough basal bark which contrasts with the smooth, greyish upper bark.

Bark: Conspicuously tessellated, compact, dark grey, brown or brown-black for 2–6 m, smooth, reddish brown or grey above. The change from rough to smooth bark is usually abrupt.

Leaves: Seedling—opposite for 3 or 4 pairs then alternate, petiolate, ovate, 4–9 × 2–4 cm, glossy, dark green, discolourous. Juvenile—alternate, petiolate, ovate, 6.5–15 × 3.5–5 cm, glossy, dark green, slightly discolourous. Intermediate—alternate, petiolate, lanceolate, 9–14 × 1.8–2.5 cm, glossy green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 6.5–12 × 0.8–1.6 cm, glossy green, concolorous.

Inflorescences: Simple, axillary, 7-flowered; peduncles angular, 0.5–2 cm long; pedicels absent or up to 0.2 cm long; hypanthia more or less cylindrical, slightly constricted at the middle, faintly striated; opercula short, rostrate; buds 1–1.1 × 0.3–0.4 cm. Flowers Feb.–May

Fruits: Sessile or very shortly pedicellate, cylindrical, though sometimes slightly constricted at the middle, often faintly striated, 0.6–1 × 0.4–0.5 cm; disc broad, steeply descending;

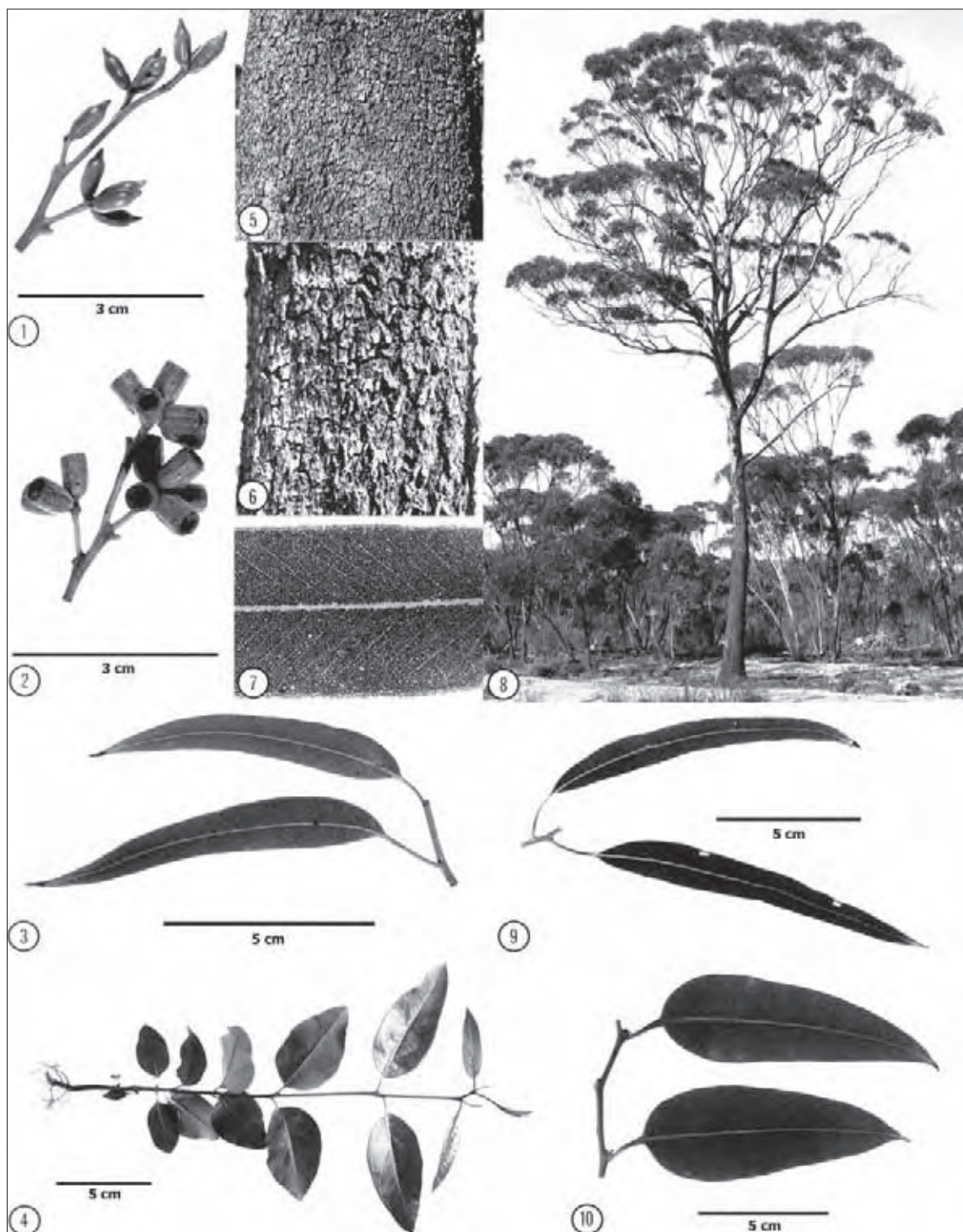


valves 3(4), often obscure, deeply enclosed. Seeds flattened-ovoid, light brown, hilum ventral.

Wood: Heartwood dark brown, hard, durable, straight-grained; density around 1100 kg m⁻³; has been used in the mining industry and is suitable for fencing.

Climate: Altitudinal range: 230–400 m; Hottest/coldest months: 31–32°C/4–5°C; Frost incidence: low to moderate (about 5 each year); Rainfall: 250–350 mm per year, slight winter max.

Distinctive features: A non-lignotuberous tree with a lower stocking of compact, grey-brown or brown-black tessellated bark, changing abruptly to smooth above; pith of branchlets glandular; inflorescences 7-flowered; buds sessile or very shortly pedicellate; fruits cylindrical, sometimes with slight ribs; leaves glossy green at all stages. The stand at Callion north of Coolgardie has pruinose branchlets.



Eucalyptus dundasii 1. Buds 2. Fruits 3. Adult leaves 4. Seedling 5, 6. Bark 7. Adult leaf venation 8. Tree, Fraser Range, east of Norseman, W.A. 9. Intermediate leaves 10. Juvenile leaves

Silver Mallet

Eucalyptus ornata Crisp

Silver mallet is a straight-boled, medium-sized mallet up to 8–10 m tall with a dbh up to 30–40 cm. The trunk is often slightly fluted or buttressed at the base. It usually branches steeply at about half tree height to form a dense terminal crown of glossy green leaves.

Silver mallet has a restricted occurrence over an 80 km range in the Kondinin–Hyden region in the south-eastern wheat belt of Western Australia. It has a restricted and patchy natural occurrence as many stands are in remnant vegetation along road verges. Larger stands are represented in nature reserves in the Hyden area.

This species forms low woodlands on gravelly, low rises or hilltops. It is normally associated with laterite breakaways. Soils are sandy loams with a conspicuous ironstone gravel component.

Silver mallet occurs in either pure stands or is most commonly associated with blue mallet (*E. gardneri*). The mallee form of merri (*E. flocktoniae*) and sand mallee (*E. eremophila*) are among other associates sometimes present.

Related species: Silver mallet belongs to a small group of four silver mallet species in series *Falcatae*, subsection *Destitutae*, a large group of species that lacks oil glands in the pith (Brooker 2000). The silver mallets are closely related to several mallee species, the best known of which is silver mallee (*E. falcata*). In these species the peduncles are notably pendulous or rigidly recurved, and the fruits are usually broader than long, often with fragile exerted style remnants surmounting the valves. Silver mallet differs from the other three silver mallets by strong ornamentation in the form of ribbing of the buds and fruits (although in some stands this difference may not always be clear cut).

Publication: *Nuytsia* 5, 311 (1985). Type: 9 km NE of Kondinin, Western Australia, 25 Sep. 1983, J. Taylor 2244 & P. Ollerenshaw.

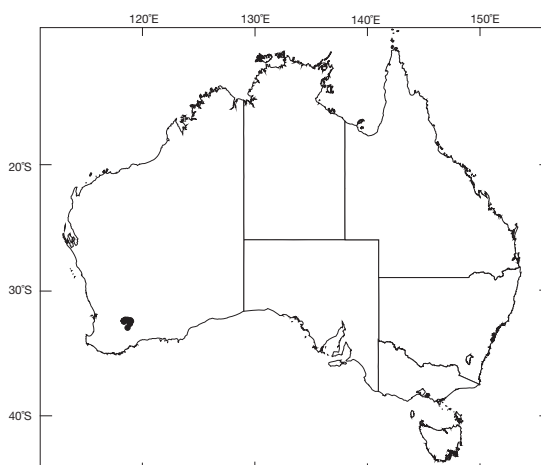
Names: Botanical—Latin *ornatus* (ornate) of the buds and fruits. Common—referring to the habit and colour of the trunk.

Bark: Smooth throughout, light grey, dark grey or silvery, shiny on close inspection.

Leaves: Seedling—opposite for 7 or 8 pairs, then alternate, petiolate, linear to elliptical, 1.2–3.5 × 1.5–2.5 cm, green. Juvenile—alternate, petiolate, ovate to elliptical, 3.5–6 × 1.5–2 cm, dull, grey-green. Adult—alternate, petiolate, lanceolate or falcate, 5–15 × 1–2.2 cm, glossy, dark green, concolorous.

Inflorescences: Simple, axillary, (7)11-flowered; peduncles recurved, slender, slightly flattened, 1.2–2 cm long; pedicels to 1.5 cm long; buds elongated with base more or less hemispherical and prominently ribbed, 1.4–2.3 × 0.7–1 cm; opercula conical to beaked. Flowers Dec.–Jan.

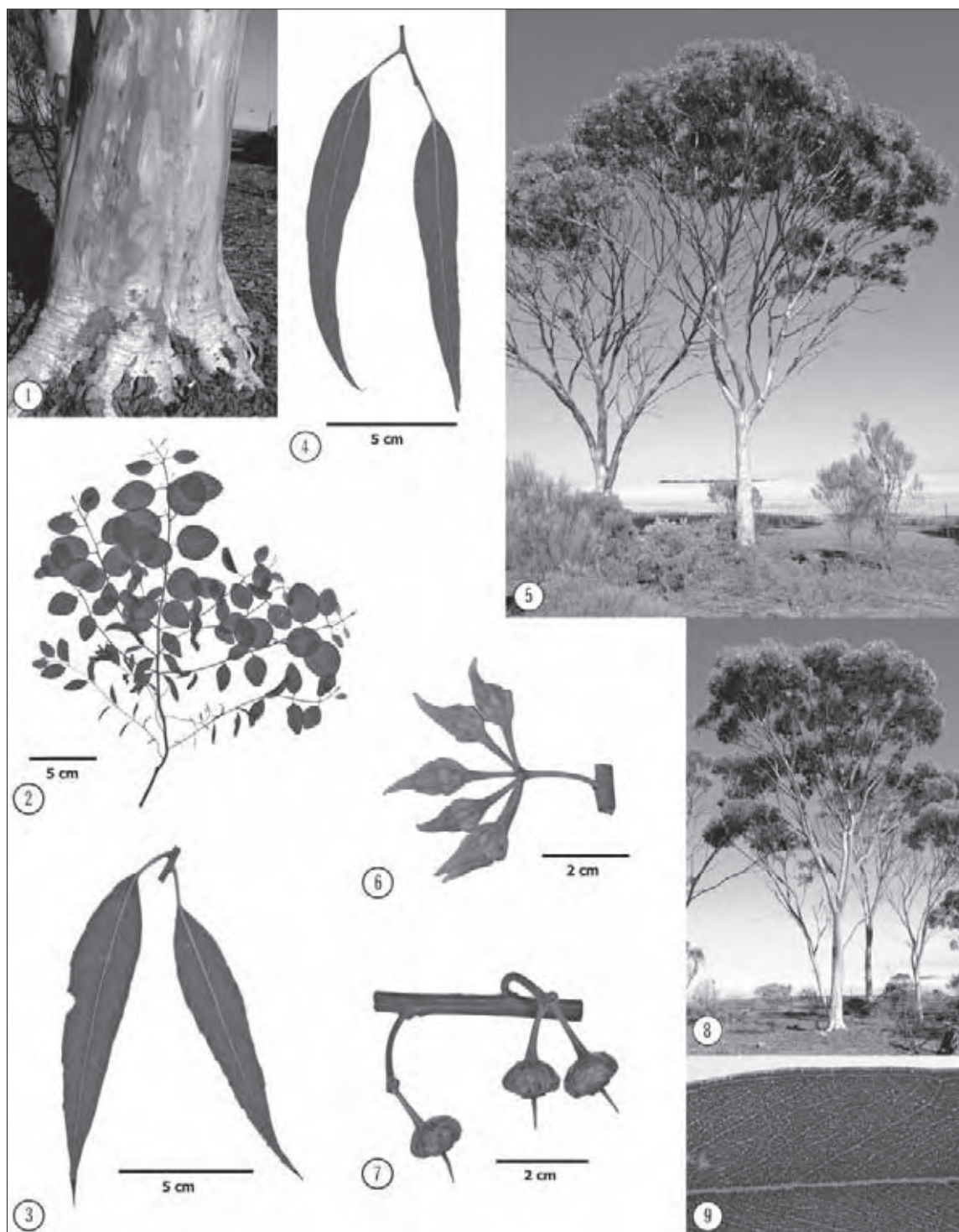
Fruits: Distinctly pedicellate, obconical to hemispherical and prominently ribbed, 0.6–1.1 × 0.9–1.3 cm; rim very thick, disc annular; valves 3 or 4, surmounted by prominent fragile style remnants. Seeds flattened-ovoid, shiny, grey, hilum ventral.



Wood: Heartwood pale brown, fine-textured, slightly interlocked, density around 1100 kg m⁻³; availability extremely limited.

Climate: Altitudinal range: 300–400 m; Hottest/coldest months: 30–32°C/4–5°C; Frost incidence: moderate (about 1–20 each year); Rainfall: 330–350 mm per year, winter max.

Distinctive features: Erect, non-lignotuberos mallet with smooth, light grey to silvery bark; adult leaves glossy, green; inflorescences pendulous; buds and fruits prominently ribbed; opercula long, conical or beaked.



Eucalyptus ornata 1. Bark 2. Seedling 3. Intermediate leaves 4. Adult leaves 5, 8. Trees, near Hyden, W.A.
6. Buds 7. Fruits 9. Adult leaf venation

Oil Mallee

Eucalyptus kochii Maiden & Blakely

Oil mallee is a typical mallee to 8 m tall, or rarely a slightly taller tree. The multiple stems arise from a lignotuberous swelling at or below ground level. The crown is made up of slightly glossy leaves, which are green to bluish green, or in the arid zone they are quite glossy. Three taxa are recognised, the typical, subsp. *plenissima* and subsp. *borealis* (= *E. 'horistes'*)—see discussion below regarding the status of this taxon).

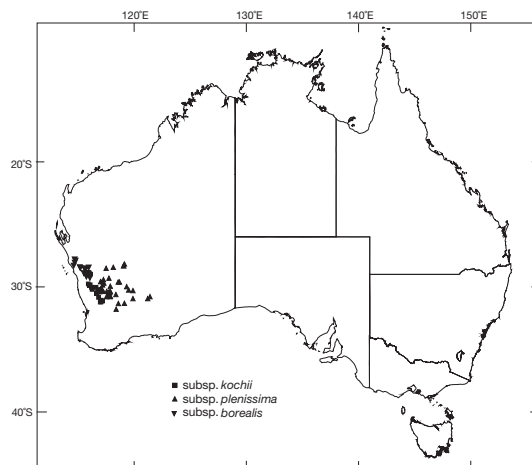
The oil mallees are widespread in the central and southern wheat belts of Western Australia, extending further inland to more arid areas. Subsp. *kochii* extends from east of Goomalling to east of Dalwallinu and to north of Wubin, subsp. *borealis* occurs north of subsp. *kochii* to north of Binnum; subsp. *plenissima*, occurs north and east of subsp. *kochii* and extends into more arid areas, e.g. east to Beacon and Southern Cross and to east of Meekatharra.

In the northern wheat belt, many occurrences of these taxa are in roadside remnants as they occupy prime agricultural country that has been mostly cleared. Oil mallees occur mainly on red soils (sands, sandy loams, clay loams or clays) derived from alluvium or laterite.

Oil mallees occur in low woodlands or shrublands. Eastern occurrences occupy mulga (*A. aneura*) dominated tall shrublands. They are associated with numerous other eucalypts, e.g. York gum (*E. loxophleba* subsp. *supralaevis*), *E. subangusta*, Dongara mallee (*E. obtusiflora*), (*E. eudesmioides* subsp. *eudesmioides*) or gimlet (*E. salubris*). Acacias such as jam (*Acacia acuminata*) and sheoaks (*Allocasuarina* spp.) may also be present.

Related species: The oil mallees belong to a large mallee group in series *Subulatae*, one of many in subsection *Destitutae*, a large group of species that lacks oil glands in the pith (Brooker 2000). The *Subulatae* occur over the whole of southern continental Australia, with a few species in the arid north in Western Australia, Northern Territory and Queensland. The series is divided into four subseries, oil mallee being in the *Oleaginae*, a subseries that includes the main high content, oil-producing species, all rough-barked. Oil mallee is closely related to *E. ultima* of the Cape Range near Exmouth, which differs in the smaller, more globular fruit. Note: recent research indicates that the name *E. 'horistes'* (Johnson and Hill 1988) is invalid as it was based on a type specimen that matches *E. hypochlamydeia*, a species in series *Porantherae*, not series *Subulatae*. Nicolle (2005) revised *E. 'horistes'* as *E. kochii* subsp. *borealis* based on an old name *E. oleosa* var. *borealis* and delineated two new subspecies, viz. subsp. *amaryssia*, which has a scattered occurrence throughout the northern Goldfields region and subsp. *yellowdinensis*, from the Bodallin–Boorabin area.

Publication: *E. kochii*: *Crit. Rev. Eucalyptus* 8, 41 (1929). Type: Watheroo Rabbit Fence, Western Australia, c. 60 miles east of Watheroo, Sep. 1905, M. Koch 1608. Subsp. *borealis* (C. Gardner) Nicolle: *Aust. Sys. Bot.* 18: 545 (2005). Type: 6–8 miles E of Canna, Jan. 1944, E.M. Watson and C.A. Gardner. Subsp. *plenissima* (C.A. Gardner) Brooker: *Aust. J. Bot.* 36, 129



(1988). Type: Between Beacon & Wialiki, 16 Jan. 1946, C.A. Gardner 8532.

Names: Botanical—honours Max Koch (1854–1925), a farmer and sawmiller from Western Australia who made many plant and seed collections; Latin *borealis* (northern), probably in reference to its northern distribution compared to other oil mallees; Latin *plen-* (full), *-issima* (very much), in reference to the oil content of the leaves. Common—refers to the high leaf oil content.

Bark: Rough over most of stems, fibrous but firmly held, grey to brown.

Leaves: Seedling—opposite, sessile to very shortly petiolate, linear for 2 or 3 pairs, then alternate, becoming narrowly elliptical, 3.3–9 × 0.5–1.5 cm, dull, grey-green to green. Juvenile—alternate, petiolate, linear to lanceolate, 7.5–10 × 1–1.7 cm, dull, grey-green. Adult—alternate, petiolate, linear to narrow-lanceolate, 5–14 × 0.5–1 cm, dull bluish green when immature, finally slightly glossy to very glossy when mature, concolorous.

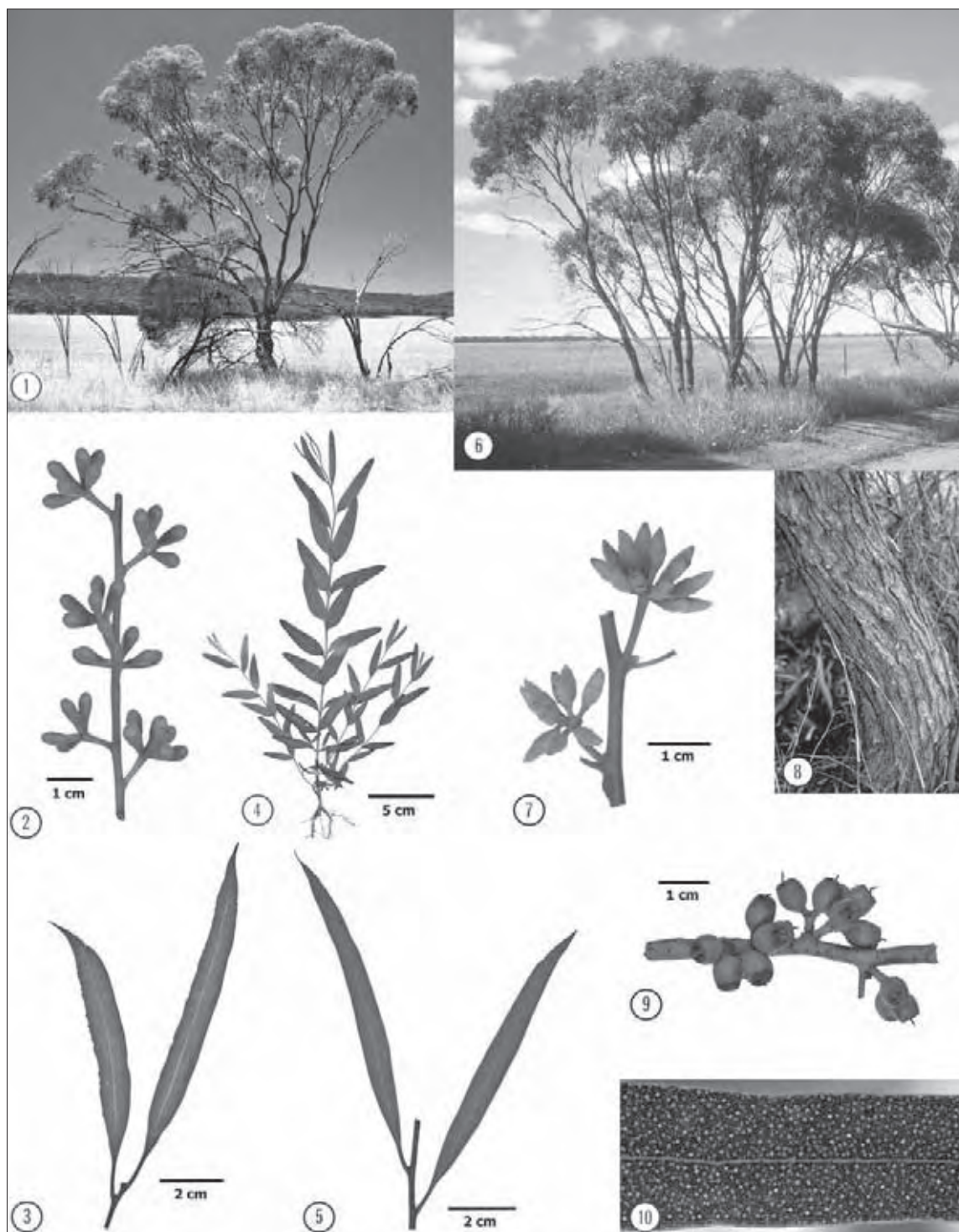
Inflorescences: Simple, axillary, (7)9 to 13-flowered; peduncles terete, 0.3–1.1 cm long; pedicellate; buds broadly fusiform (*kochii*, *borealis*) or clavate (*plenissima*), 0.7–1 × 0.3–0.4 cm; opercula conical (*kochii*), beaked (*borealis*), hemispherical (*plenissima*). Flowers Sept.–Feb.

Fruits: Shortly pedicellate, truncate-globose to urceolate, 0.5–0.8 × 0.5–0.7 cm; disc descending; valves 3 or 4, enclosed and surmounted by prominent, exerted fragile style remnants. Seeds flattened-ovoid, shiny grey, hilum ventral.

Wood: Density around 1050 kg m⁻³; like all eucalypt mallee species the mature lignotuber makes an excellent firewood.

Climate: Altitudinal range: 185–550 m; Hottest/coldest months: 33–37°C/4–7°C; Frost incidence: low to moderate; Rainfall: 230–375 mm per year, winter max.

Distinctive features: Rough-barked mallees; adult leaves slightly glossy to distinctly glossy, bluish green; fruits truncate-globose to urceolate with prominent, exerted fragile style remnants.



Eucalyptus kochii: subsp. *kochii* (k), subsp. *borealis* (b), subsp. *plenissima* (p) 1. Tree, near Wongan Hills, W.A. (k) 2. Buds (p) 3. Adult leaves (k) 4. Seedling (k) 5. Adult leaves (p) 6. Mallee, near Binnu, W.A. (b) 7. Buds (k) 8. Bark 9. Fruits (p) 10. Adult leaf venation

Red Morrell Poot

Eucalyptus longicornis (F. Muell.) F. Muell. ex Maiden

Red morrell is a medium-sized to tall tree, to 25 m tall and dbh up to 80 cm. The tree is usually erect, branching at about half tree height to form a crown of glossy green leaves crowded towards the end of the branches.

This species is widespread in the Western Australian wheat belt and Goldfields region from Wongan Hills near Dandaragan in the north, south to Broomehill and east to Southern Cross.

Red morrell occurs in lower parts of the topography on fine-textured calcareous loams that have clay at depth. Soils are mainly derived from highly weathered granite, aeolian clay deposits from nearby salt lakes or alluvial sediments. They are sometimes saline, particularly those close to salt lake systems.

Red morrell usually grows in open eucalypt woodlands, associated with a wide range of other eucalypts, such as salmon gum (*E. salmonophloia*), yorrell (*E. yilgarnensis*), gimlet (*E. salubris*), black morrell (*E. melanoxylon*) and *E. myriadena*.

Related species: Red morrell belongs to a large group of species in series *Subulatae* (Brooker 2000). The *Subulatae* lack oil glands in the pith and occur over the whole of southern continental Australia, with a few species in the arid north of Western Australia, Northern Territory and Queensland. The series is divided into four subseries, red morrell being in the *Spirales*, a subseries that is recognised by the rare seedling form of crowded, spirally arranged leaves. In this respect it is closely related to the widespread mainly eastern *E. oleosa*, which is always a mallee and has characteristic 'egg-in-an-eggcup' buds with shorter opercula. A similar tree in the wheat belt and Goldfields, is black morrell (*E. melanoxylon*) which is unrelated and is distinguished by the glandular pith, and shorter opercula enclosing inflexed stamens (irregularly flexed in red morrell).

Publication: *E. longicornis*: J. and Proc. Roy. Soc. New South Wales 52, 504 (1919). Type: Western Australia, Upper Swan River, 1877, F. Mueller.

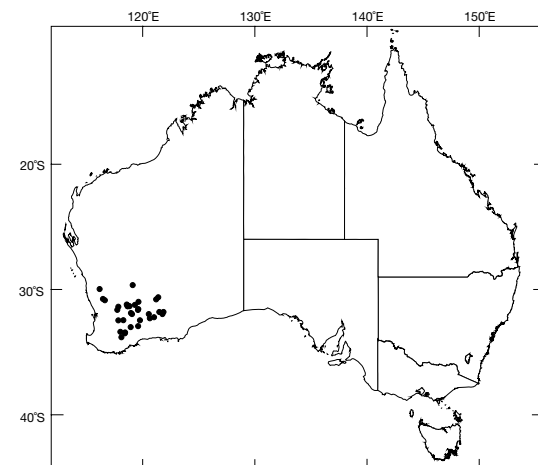
Names: Botanical—Latin *longi* (long), *cornis* (horned), describes the operculum. Common—the colour of the timber is reddish and *morrell* is an Aboriginal name for the tree.

Bark: Rough over whole trunk, thick, fibrous but firmly held, grey-brown to dark brown.

Leaves: Seedling—opposite, sessile, linear for 2 or 3 pairs, then spirally arranged, becoming narrowly elliptical, 0.6–1.7 × 0.1–0.7 cm, dull grey-green to green. Juvenile—spirally arranged, sessile, petiolate, linear to elliptical, 2–10 × 1–3 cm, dull grey-green, finally reverts to decussate. Intermediate—subopposite to alternate, shortly petiolate, elliptical to broad-lanceolate, 3–12 × 0.8–2.2, grey-green to green. Adult—alternate, petiolate, narrow-lanceolate, 5–14 × 0.6–1.2 cm, glossy, green.

Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles 0.6–2.4 cm long; pedicellate; buds broadly fusiform, 0.9–1.3 × 0.4–0.5 cm; opercula narrowly conical. Flowers Dec.–Feb.

Fruits: Shortly pedicellate, barrel-shaped to truncate-globose, 0.4–0.9 × 0.5–0.7 cm; disc descending; valves 3 or 4, enclosed



and surmounted by prominent, exerted fragile style remnants. Seeds flattened-ovoid, shiny grey, hilum ventral.

Wood: Heartwood reddish to dark red-brown with purplish tinge sometimes with patches of pink and grey, with interlocking grain sometimes wavy; texture fine to very fine; density 1070–1170 kg m⁻³; in the past used as mining timber and fuel wood; recent uses include flute head joints; attractive on quartersawn surfaces; has considerable potential for fine furniture.

Climate: Altitudinal range: 220–500 m; Hottest/coldest months: 28–35°C/4–6°C; Frost incidence: low to moderate (about 1–20 each year); Rainfall: 250–520 mm per year, winter max.

Distinctive features: Usually a tall, rough-barked tree with crown of glossy green leaves; fruits truncate-globose to urceolate with prominent, exerted fragile style remnants.



Eucalyptus longicornis 1. Bark 2. Fruits 3. Intermediate leaves 4. Juvenile leaves 5. Seedling 6. Buds 7. Adult leaves 8. Coppice leaves 9. Tree, Hyden Track, W.A. 10. Juvenile plant 11. Adult leaf venation

Merrit

Eucalyptus urna Nicolle

Merrit is an erect, small to medium-sized mallet, up to 10 m tall, but may be up to 16 m tall at some sites. The trunk breaks at about 1.5–6 m to form steep branches and a distinctly terminal, shiny, green-leaved crown.

Merrit is a widespread species of southern Western Australia, from Kondinin and Lake Grace in the south-west, east towards Caiguna on the edge of the Nullarbor Plain, and north to about Coolgardie. It is mostly an inland species but approaches the coast near Toolinna Cove on the western side of the Great Australian Bight. Many stands now occur as roadside remnants.

This species usually grows on red calcareous loams, red clay loams or brown sandy loams. Substrates include limestone, granite and laterite.

Merrit is associated with a diverse range of eucalypts, including salmon gum (*E. salmonophloia*), square-fruited mallee (*E. calycogona*), gimlets (*E. diptera*, *E. salubris*, *E. terebra*), tall sand mallee (*E. eremophila*), Fraser Range gum (*E. fraseri*) and Dundas blackbutt (*E. dundasii*).

Related species: Merrit belongs to a large group of species in series *Subulatae*, one of many in subsection *Destitutae*, a large group of species that lacks oil glands in the pith (Brooker 2000). The series is divided into four subseries, merrit being in the *Decurrentes*, a subseries that is recognised by the unusual seedling and juvenile leaves that are conspicuously decurrent at the leaf bases. The subseries comprises two groups, one in which the leaves are glossy green (e.g. *E. urna*) and the other that has dull leaves (e.g. *E. transcontinentalis*). Merrit is related to three other species, viz. *E. flocktoniae*, *E. peninsularis* and *E. neutra*, which all differ in having a mallee habit and smooth or much less sculptured buds. Four taxa, including *E. urna*, *E. peninsularis* and *E. neutra*, were recognised in the 'E. flocktoniae group' by Nicolle and Conran (1999).

Publication: *Aust. Sys. Bot.* 12, 227 (1999). Type: Western Australia: 0.6 km along Old Ravensthorpe Rd. from Lake King–Newdegate road, 21 Jul. 1988, M.I.H. Brooker 10008.

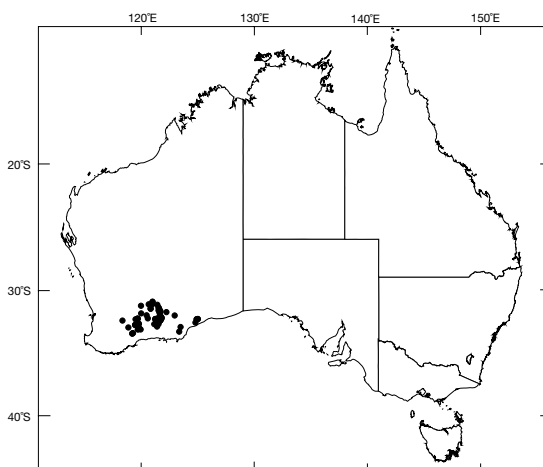
Name: Botanical—Latin *urna* (an urn, the fruits are distinctly urn-shaped). Common—of Aboriginal origin.

Bark: Smooth throughout, grey or silvery to orange-brown.

Leaves: Seedling—opposite, sessile, for numerous pairs, at first linear, soon becoming strongly decurrent and deltoid to ovate, c. 3 × 2.5 cm, dull to slightly glossy, slightly bluish green to grey-green. Juvenile—gradually change from the seedling leaves, otherwise similar, but larger and sometimes bluish green. Adult—alternate, petiolate, lanceolate, 7–14 × 0.8–2.8 cm, very glossy, dark green.

Inflorescences: Simple, axillary, 7 to 13-flowered; peduncles down-curved, 0.7–1.6 cm long; pedicels 0.4–1.1 cm long; buds 1.2–1.7 × 0.3–0.5 cm, hypanthia urceolate, ribbed; opercula strongly beaked, 0.7–1.3 cm long. Flowers Sept.–Mar.

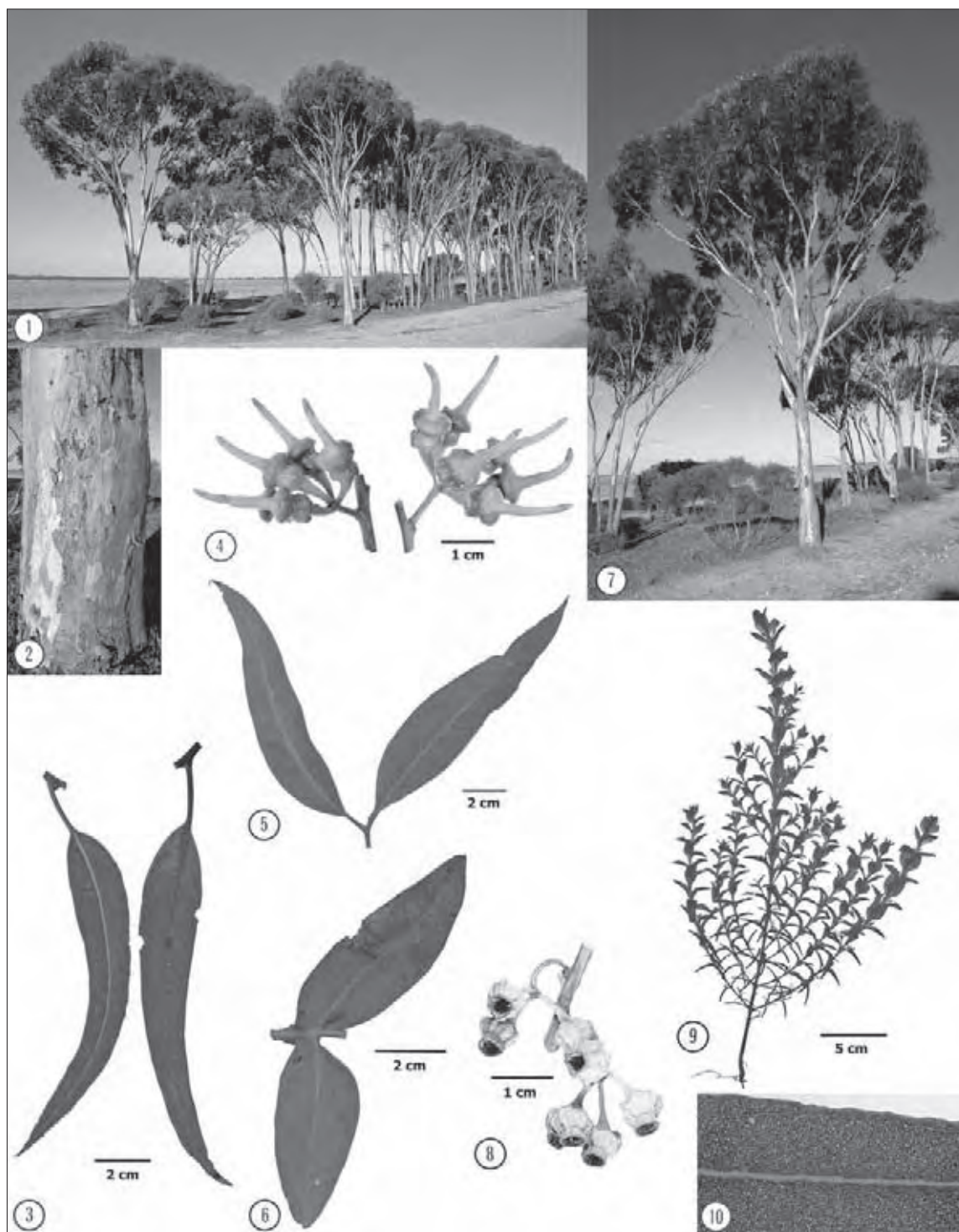
Fruits: Pedicellate, urceolate, ribbed, 0.7–1.1 × 0.6–1.1 cm; disc descending; valves 3(4), enclosed, sometimes surmounted by prominent, exserted fragile style remnants. Seeds flattened-ovoid, shiny grey, hilum ventral.



Wood: Heartwood, red, dense, durable; density around 1100 kg m⁻³; recently used as head joints for flutes.

Climate: Altitudinal range: 270–410 m; Hottest/coldest months: 28–32°C/4–5°C; Frost incidence: low to moderate; Rainfall: 250–360 mm per year, winter max.

Distinctive features: Erect, non-lignotuberous, smooth-barked mallet with crown of glossy, dark green leaves; buds and fruits constricted around the middle and strongly ribbed.



Eucalyptus urna 1, 7. Stand and tree near Lake King, W.A. 2. Bark 3. Adult leaves 4. Buds 5. Intermediate leaves 6. Juvenile leaves 8. Fruits 9. Seedling 10. Adult leaf venation

Caesia Silver Princess

Eucalyptus caesia Benth.

In natural stands this species is a sprawling mallee, often with an untidy growth habit. There are two forms: subsp. *caesia*, has more or less erect stems and is 6–8 m tall; subsp. *magna*, is typically larger, up to 10 m tall and has pendulous branchlets that may reach to ground level. In the field, these plants are conspicuous for their densely pruinose branchlets, buds and fruits and the unusual peeling, reddish bark.

The two forms of this species are of very sporadic occurrence in the southern wheat belt of Western Australia, extending into drier country to the north-east. The scattered nature of the distribution is due to the exclusive occurrence of the species on isolated granite rocks. The smaller subsp. *caesia* is the more widespread and occurrences include Boyagin Rock, Mount Caroline, The Humps and Yanneymooning Rock. The taller subsp. *magna* occurs on Chiddarcooping Hill, Chutawalakin Rock and Billycatting Hill in the eastern central wheat belt.

Both forms are confined to granite outcrops where they grow in crevices and around the base of rocks. Soils are typically skeletal loams that include a coarse sand component.

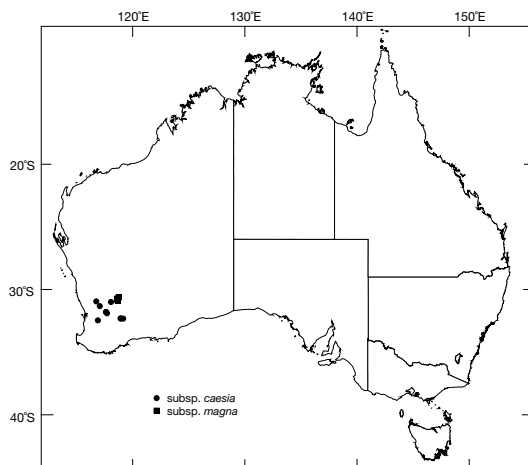
They occur in low woodlands and while often in pure stands, they may also be associated with silver mallee (*E. crucis*), York gum (*E. loxophleba*), rock oak (*Allocasuarina huegeliana*) and wilyurwur (*Acacia lasiocalyx*).

Related species: *Caesia* belongs to series *Caesia*, one of many in subsection *Destitutae*, a large group of species that lacks oil glands in the pith (Brooker 2000). The series is one of only two groups in the genus *Eucalyptus* recognised by the distinctive red-brown colour and the unusual way in which the bark is partly shed. This bark sheds in fine, longitudinal splits, also seen in the *E. orbifolia* group (subseries *Orbifoliae*). The mostly urceolate fruits of *caesia* distinguish them from the *E. orbifolia* group whose fruits are obconical or hemispherical with a prominent, broad disc, whereas the disc in *caesia* is strongly descending.

Publication: *E. caesia*: *Fl. Austral.* 3, 227 (1867). Type: W.A., J. Drummond, 5, suppl. 36. Subsp. *magna* Brooker and Hopper: *Nuytsia* 4, 117 (1982). Type: Chutawalakin Hill, 24 Aug. 1979, M.I.H. Brooker 6488.

Names: Botanical—Latin *caesius* (bluish grey), of the appearance of the whole adult plant; Latin *magnus* (large), of the buds and fruits compared with the typical subspecies. Common—the names *caesia* and silver princess (for subsp. *magna*) are in horticultural use. In the past, *caesia* was sometimes referred to as gungurru (see *E. woodwardii* regarding the correct application of this name).

Bark: Dark red to red-brown bark, smooth to ground level, decorticating in fine longitudinal splits, with each split peeling to expose strips of smooth greenish bark. Due to the similarity of bark colour, this bark type has been confused with Minni Ritchi bark seen in about 20 species of *Acacia* from section *Juliflorae*. Minni Ritchi bark differs by shedding in short, narrow shavings, which curl back to form a 'hairy' appearance.



The name 'Minni Ritchi' is of Aboriginal origin applied to *Acacia* species that have this bark type.

Leaves: Seedling—opposite for about 5 pairs, petiolate, cordate, 2.5–6 × 2.5–5 cm, glossy green. Juvenile—alternate, petiolate, cordate, 5–8 × 2.5–6 (*caesia*) or 6–10 × 5.5–8 (*magna*), very glossy green. Adult—alternate, petiolate, lanceolate, 7–13.5 × 1.2–2.6 cm (*caesia*) or 9–24 × 2.2–5 cm (*magna*), dull light green to bluish green, concolorous.

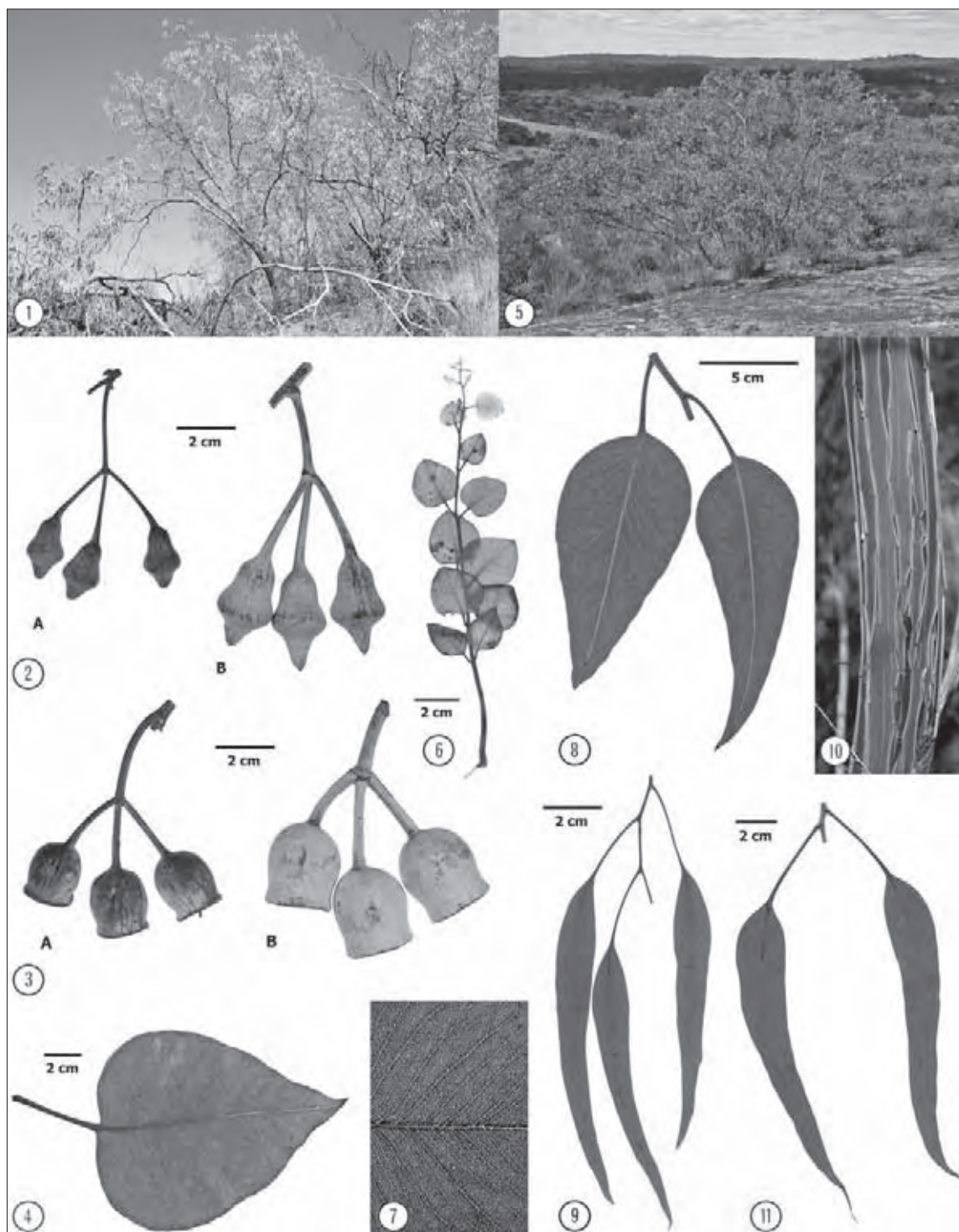
Inflorescences: Simple, axillary, 3-flowered; peduncles pendulous, terete, 1.4–3.5 cm long; pedicellate; buds ovoid to clavate, 1.6–2.7 × 0.9–1.1 cm (*caesia*), 3–4 × 1.8–2 cm (*magna*), opercula conical to slightly beaked, not scarred but with shallow encircling 'ridge' halfway up; filaments pink (*caesia*) or red (*magna*). Flowers May–Aug.

Fruits: On long pedicels, cupular to urceolate, 1.5–2.6 × 1.5–2.2 cm (*caesia*) or 2.8–3.7 × 2–3.7 cm (*magna*); disc broad, descending; valves (4)5 or 6(7), enclosed. Seeds ovoid to cuboid, grey-black, hilum ventral.

Wood: Light coloured, otherwise poorly known.

Climate: Altitudinal range: 300–450 m; Hottest/coldest months: 31–34°C/4–6°C; Frost incidence: moderate; Rainfall: 250–500 mm per year, winter max.

Distinctive features: Colourful dark red to red-brown bark that decorticates in fine longitudinal splits, large glossy green juvenile leaves, completely pruinose adult plant, 3-budded pendulous inflorescences, pink or red flowers, and large urceolate fruits. A common amenity plant in urban areas of south-western Western Australia, South Australia and Victoria.



Eucalyptus caesia: subsp. *caesia* (c), subsp. *magna* (m) 1. Tree, Chiddarcooping Rock, W.A. (m) 2. Buds, A (c), B (m) 3. Fruits, A (c), B (m) 4. Juvenile leaf 5. Mallee, Mt Caroline, W.A. (c) 6. Seedling 7. Adult leaf venation 8. Intermediate leaves 9. Adult leaves (c) 10. Bark 11. Adult leaves (m)

Salt Gum Salt Lake Salmon Gum

Eucalyptus salicola Brooker

Salt gum is a small to medium-sized tree to 15 m tall and with a dbh to 50 cm. The trunk usually branches at less than half tree height to form a crown of narrow, glossy green leaves. In the field, salt gum is similar in appearance to salmon gum, but does not attain its height.

It is a widespread but sporadically distributed species of the wheat belt of Western Australia. It extends east from Lake Moore in the north and Lake Buchan in the south, through the goldfields into the Great Victoria Desert to near Lake Rason and Lake Minigwal.

Salt gum is notable for its exclusive occurrence around salt lakes or clay pans where it favours gypseous sands and sandy loams derived from aeolian or alluvial deposits.

When in pure stands salt gum is associated mainly with low chenopod shrublands. When in mixed eucalypt woodlands it may be with a range of species that include Kondinin blackbutt (*E. kondininensis*), swamp mallet (*E. spathulata*), *E. quadrans*, *E. cylindrocarpa*, York gum (*E. loxophleba*), Goldfield's blackbutt (*E. lesouefii*) and snap-and-rattle (*E. gracilis*).

Related species: Salt gum belongs to a large group of species in series *Porantherae*, which belongs in subsection *Destitutae*, a large group that lacks oil glands in the pith (Brooker 2000). Salt gum has probably been mistaken for the unrelated, well-known salmon gum (*E. salmonophloia*), which is more widespread in the wheat belt and goldfields, but is not adapted to salt-lake environments. The two species look similar with the bark colour, but salmon gum is usually a taller, straighter tree, with linear juvenile leaves. Salt gum shares the pruinose, opposite, roundish juvenile leaves of several related species, including *E. horistes* (syn. *E. hypochlamydea*) of the northern wheat belt of Western Australia, which is a mallee or tree with variably rough bark, and *E. fruticosa* from north of Kalbarri National Park, which is a sprawling mallee with rough bark and a crown of mostly juvenile leaves.

Publication: *Nuytsia* 6, 329 (1988). Type: 14.6 km east of Kulja Central road on Mollerin North road, 24 Jan. 1984, M.I.H. Brooker 8433 and S.D. Hopper.

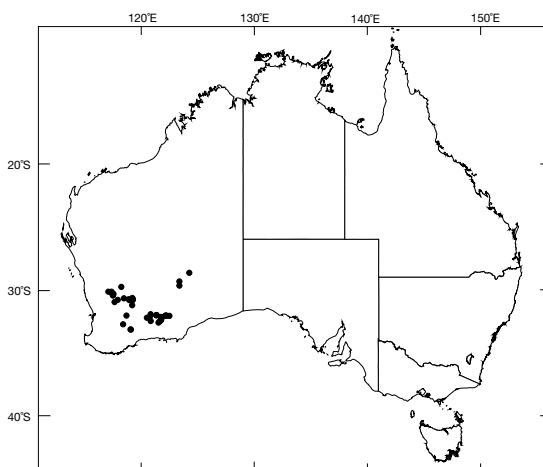
Names: Botanical—Latin *sali* (of salt), *cola* (dweller), referring to the habitat. Common—refers to the habitat.

Bark: Smooth throughout, usually powdery, white, grey, or salmon pink.

Leaves: Seedling—opposite for many pairs, sessile, cordate to orbicular, 0.8–2.7 × 0.5–2 cm, grey-green to slightly pruinose, discolorous. Juvenile—opposite then subopposite, sessile, orbicular to ovate, 1–2.5 × 0.7–2 cm, dull, pruinose. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 3.5–10.5 × 0.4–1.2 cm, glossy, green, concolorous.

Inflorescences: Simple, axillary, (7)11-flowered; peduncles slightly angular, 0.4–0.9 cm long; pedicellate; buds ovoid to fusiform, about 0.8 × 0.3 cm; opercula conical to beaked. Flowers Feb.–Mar.

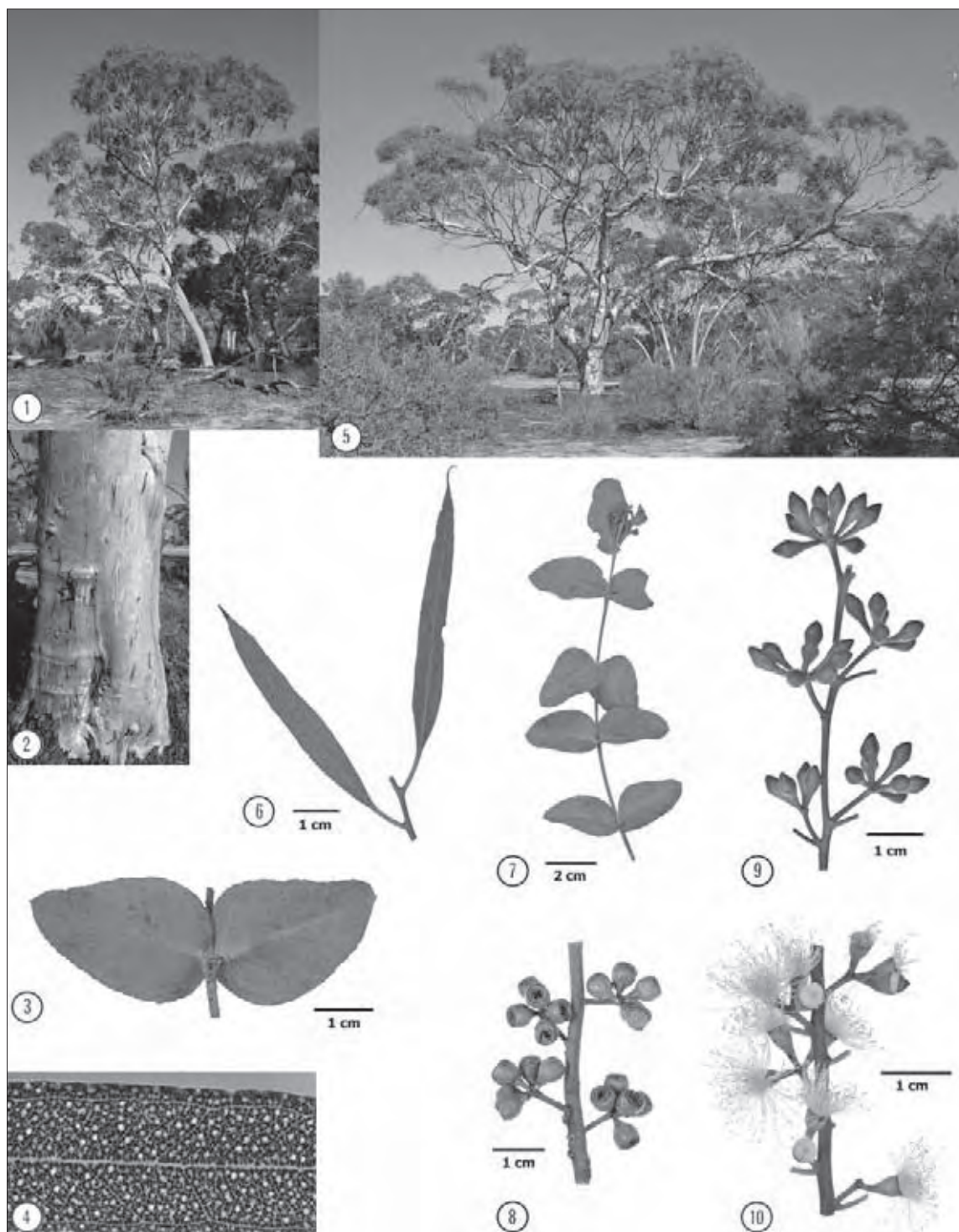
Fruits: Pedicellate, cupular to hemispherical or slightly urceolate, c. 0.5 × 0.4 cm; rim thick, disc descending, whitish; valves 3(4), to rim level or enclosed. Seeds flattened-ovoid, brown, hilum ventral.



Wood: Heartwood brownish red; density 940 kg m⁻³; has potential for woodturning but is in limited supply.

Climate: Altitudinal range: 150–400 m; Hottest/coldest months: 30–36°C/4–6°C; Frost incidence: low to moderate; Rainfall: 200–350 mm per year, winter max. to uniform.

Distinctive features: Tree with bark like a salmon gum, growing around salt-lakes; juvenile leaves opposite, roundish, pruinose; adult leaves glossy green; fruits with inward-sloping whitish disc.



Eucalyptus salicola 1, 5. Tress, Lake Deborah, W.A. 2. Bark 3. Juvenile leaves 4. Adult leaf venation 6. Adult leaves 7. Seedling 8. Fruits 9. Buds 10. Flowers

■ Gums

Eucalyptus section *Maidenaria* L.D. Pryor & L.A.S. Johnson ex Brooker

This section is very large, consisting of more than 70 species divided into many taxonomic series. They are exclusively south-eastern in distribution and occur from lower Eyre Peninsula at the western limit, around the coast and adjacent tablelands and ranges as far as lower south-eastern Queensland. Several species occur in Tasmania, including some endemics.

The great majority of the species are trees, varying from the small, narrow-leaved black peppermint (*E. nicholii*) to giant trees such as manna gum (*E. viminalis*). A few species are usually shrubs, for example, varnished gum (*E. vernicosa*), although in cultivation they sometimes grow into small trees. The species occupy a wide variety of habitats and a wide altitudinal range. Swamp gum (*E. ovata*) and to a lesser extent black gum (*E. aggregata*) are adapted to freshwater swamps, Wallangarra white gum (*E. scoparia*) grows exclusively on well-drained granite hill tops, white-topped box (*E. quadrangulata*) grows on rainforest fringes, candlebark (*E. rubida*) can occur at high altitudes where snow lies on the ground for some time each year, while manna gum (*E. viminalis*), the most widespread species of the section, is adapted to habitats from sea level to mountain valleys. No species of the group extends into the tropics or the true arid zone. Perhaps the remotest occurrence is that of the shrubby form of long-leaved box (*E. goniocalyx* subsp. *exposita*) on the peaks in the northern Flinders Ranges in South Australia.

The most important group of species in the section is the southern blue gums, which are valuable timber producers, e.g. mountain grey gum (*E. cypellocarpa*), shining gum (*E. nitens*) and Tasmanian blue gum (*E. globulus*). The latter two in particular are important plantation species in Australia and as fast-growing exotics overseas.

Several species are ornamental. These include the fine-leaved, white-trunked brittle gum (*E. mannifera*), *E. scoparia*, the silver-leaved

Victorian silver gum (*E. crenulata*) and Argyle apple (*E. cinerea*). Small-leaved gum (*E. parvula*), *E. nitens* and Tingaringy gum (*E. glaucescens*) are notably cold-tolerant and are important in cultivation for this characteristic.

Botany

Section *Maidenaria* is diagnosed within *Symphomyrtus* by the reniform or bilobed cotyledons, the more or less sessile seedling leaves and axillary inflorescences.

Bark is variable from species to species. White-topped box (*E. quadrangulata*) has typical, finely fibred box-type bark. Camden woollybutt (*E. macarthurii*) has much coarser box-type bark. Gully gum (*E. smithii*) and Big Badja gum (*E. badjensis*) have very compacted bark and from a distance both species can be mistaken for river peppermint (*E. elata*) with a similar bark. *E. cinerea* has almost a stringy bark. The species of commercial importance are mostly gum-barked although *E. viminalis* is very variable in the amount of basal, rough bark, and tree forms of *E. glaucescens* always have a stocking of rough bark.

Some species are mature in the juvenile leaf phase, e.g. *E. crenulata*, silver-leaved mountain gum (*E. pulverulenta*) and *E. cinerea*, although in the latter two species intermediate and occasionally adult leaves develop on the older plants.

Heterophylly is probably more striking in *Maidenaria* than in any other group in *Eucalyptus* and the changeover from the long-lasting juvenile phase in *E. globulus* to the remarkably different intermediate phase is readily seen on saplings both in the field and in cultivation. *Eucalyptus globulus* and its close relative *E. bicostata* are notable as well for producing the largest adult leaves in the genus.

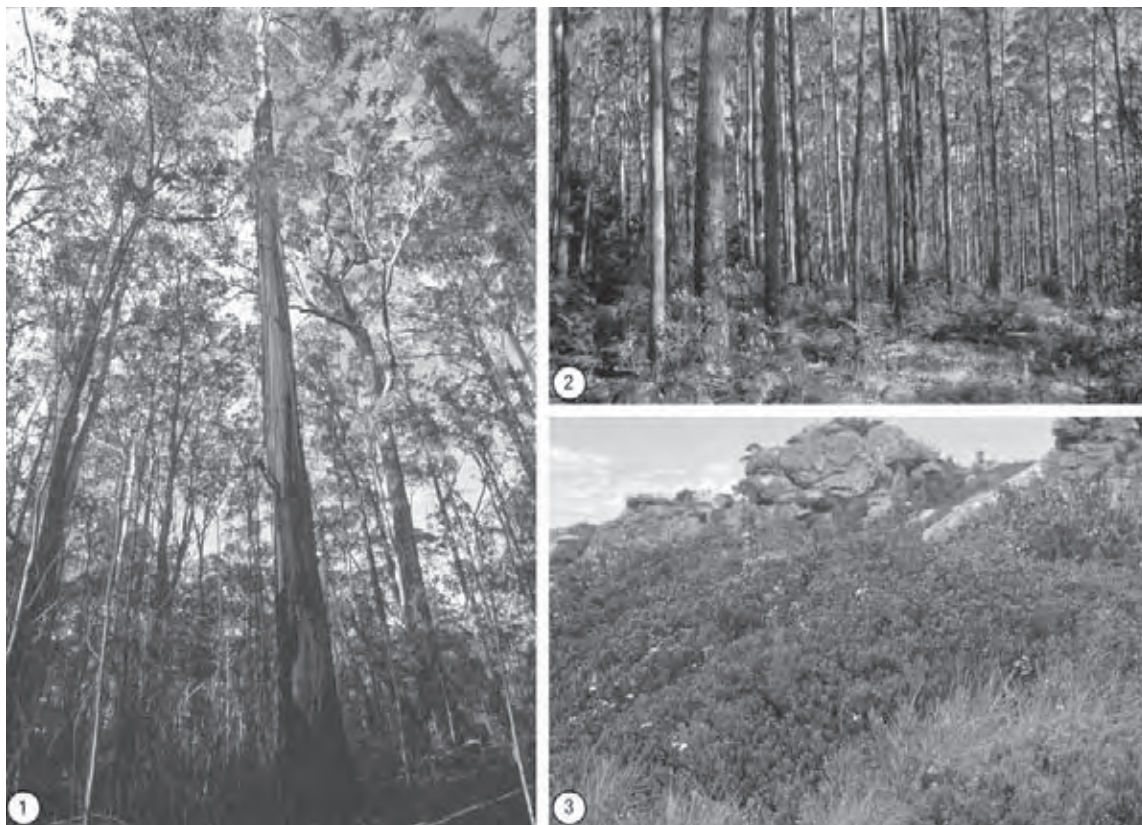
Bud numbers are useful for identifying some individual species and groups of species. Many species are 3-flowered, notably *E. viminalis*, *E. cinerea* and *E. bicostata* and most of the Tasmanian endemics, such as the yellow gums (e.g. *E. subcrenulata*, *E. gunnii* and *E. archeri*). Other species are regularly 7-flowered, e.g.

E. macarthurii and *E. smithii*, while *E. vernicosa* is 1 or 3-flowered and *E. globulus* is regularly 1-flowered. When mature inflorescences are seen to have unusual numbers (e.g. 2s, 5s, 6s), these instances are most likely to have occurred through the loss of one or more buds during development. In most mainland species the staminal filaments are irregularly flexed, exceptions being *E. cinerea* and related species in which they are inflexed. The Tasmanian endemics mostly have inflexed stamens. The anthers of all species are oblong, versatile and open by longitudinal slits.

Fruit size is very variable. The fruits of black gum (*E. aggregata*) are among the smallest in the

genus while the fruits of *E. globulus* are large compared with other eastern species.

Pruinescence is a feature of some species especially in the juvenile and coppice leaves, e.g. apple box (*E. bridgesiana*), *E. globulus*, *E. rubida*, *E. pulverulenta* and *E. cinerea*. In contrast the young leaves of apple-topped box (*E. angophoroides*), *E. smithii*, *E. viminalis* and *E. badjensis* are green. The white wax is lost in many species after the juvenile phase, but is generally maintained in the inflorescence structures in species which mature in a pre-adult leaf phase, e.g. *E. crenulata*, *E. pulverulenta* and *E. cinerea*. The southern blue gums, in contrast, develop green adult foliage but have pruinose buds and fruits.



Species from section *Maidenaria* occur mainly in south-eastern Australia and range in habit from tall trees to low shrubs. 1. Big Badja gum (*Eucalyptus badjensis*), Brown Mountain, N.S.W. (image: O. Strewe). 2. Stand of maturing white gum (*E. nobilis*), near Wauchope, N.S.W. 3. Varnished gum (*E. vernicosa*), Sentinel Range, Tas.

Swamp Gum Black Gum (southern Tas.), White Gum

Eucalyptus ovata Labill.

Swamp gum is usually a medium-sized or occasionally a tall tree attaining 30 m in height and up to 1 m dbh, but in cold, poorly drained swamps it also occurs as a stunted tree. Under favourable conditions it has a clear, straight trunk for about half the tree height and a moderately dense crown.

Swamp gum is widely distributed in south-eastern Australia including Tasmania and the eastern Bass Strait islands. In Tasmania it has been confused with *E. brookeriana*, which also occurs on King Island and some highlands near Melbourne. In Victoria, *E. ovata* has a scattered distribution in many areas except the dry north and north-west. It occurs on the Central and Southern Tablelands of New South Wales, and in South Australia it is found in the hills south of Adelaide, in the south-east of the State and on Kangaroo Island. A minor variant, var. *grandiflora*, occurs in the south-east of South Australia and far western Victoria and has larger, more glandular adult leaves, and larger buds and fruits. It may be difficult to distinguish these two variants in areas where they overlap.

This species grows on a variety of sites from exposed coastal plains to mountain foothills. Soils are generally sands and clays, very frequently with poor drainage, though in some areas it occurs on well-drained sites.

Swamp gum occurs in open forests or woodlands and due to its wide geographical range has many associated eucalypts, including manna gum (*E. viminalis*), snow gum (*E. pauciflora*), white peppermint (*E. pulchella*), broad-leaved peppermint (*E. dives*), apple box (*E. bridge-siana*), black sallee (*E. stellulata*), Smithton peppermint (*E. nitida*) and candlebark (*E. rubida*).

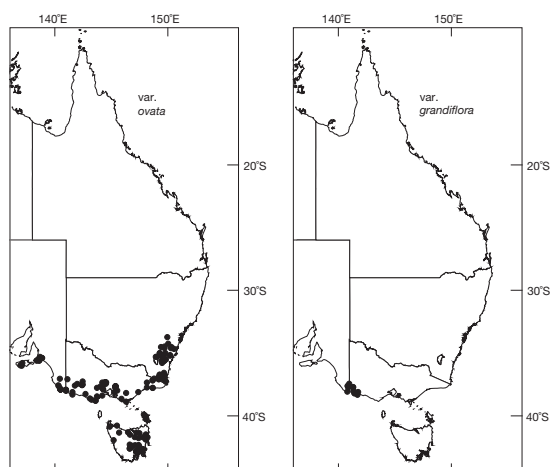
Related species: Swamp gum belongs in a group of about eight or nine species, most of which are swamp dwellers, series *Foveolatae* (Brooker 2000). Swamp gum is closely related to Yarra gum (*E. yarraensis*), an endemic to southern and central Victoria, which has rough bark and smaller adult leaves, buds and fruits. Swamp gum was long confused with Brooker's gum (*E. brookeriana*) of Tasmania and southern Victoria, which usually occurs in more fertile, better-drained soils and differs by the crenulate juvenile leaves, basal rough bark, discoloured prominently glandular adult leaves with a high cineole content. Swamp gum typically has virtually glandless leaves.

Publication: Var. *ovata*: Nov. Holl. Pl. 2, 13 (1806). Type: Tasmania, J. Labillardière. Var. *grandiflora* Maiden: Crit. Revis. *Eucalyptus* 3: 146 (1916). Type: Glencoe, 15 miles from Mt Gambier, S.A., Jan. 1904, W. Gill.

Names: Botanical—Latin *ovatus* (ovate), of the leaf shape (mainly juvenile and intermediate). Common—refers to habitat.

Bark: Shed from the trunk and branches in ribbons, leaving a smooth white, cream or pink surface; usually retained at the base in a dark grey, rough stocking.

Leaves: Seedling—opposite for up to 11 pairs then alternate, sessile or very shortly petiolate, elliptical or ovate, 3–10 ×



1–3.5 cm, green, discoloured. Juvenile—alternate, petiolate, elliptical or ovate, 5–19 × 3–8.5 cm, green, slightly to distinctly discoloured. Intermediate—alternate, petiolate, ovate, 9.5–19 × 2.5–5 cm, glossy green, concolorous. Adult—alternate, petiolate, ovate to lanceolate, 8–17 × 1.7–2.8 cm, glossy green, concolorous, often undulate.

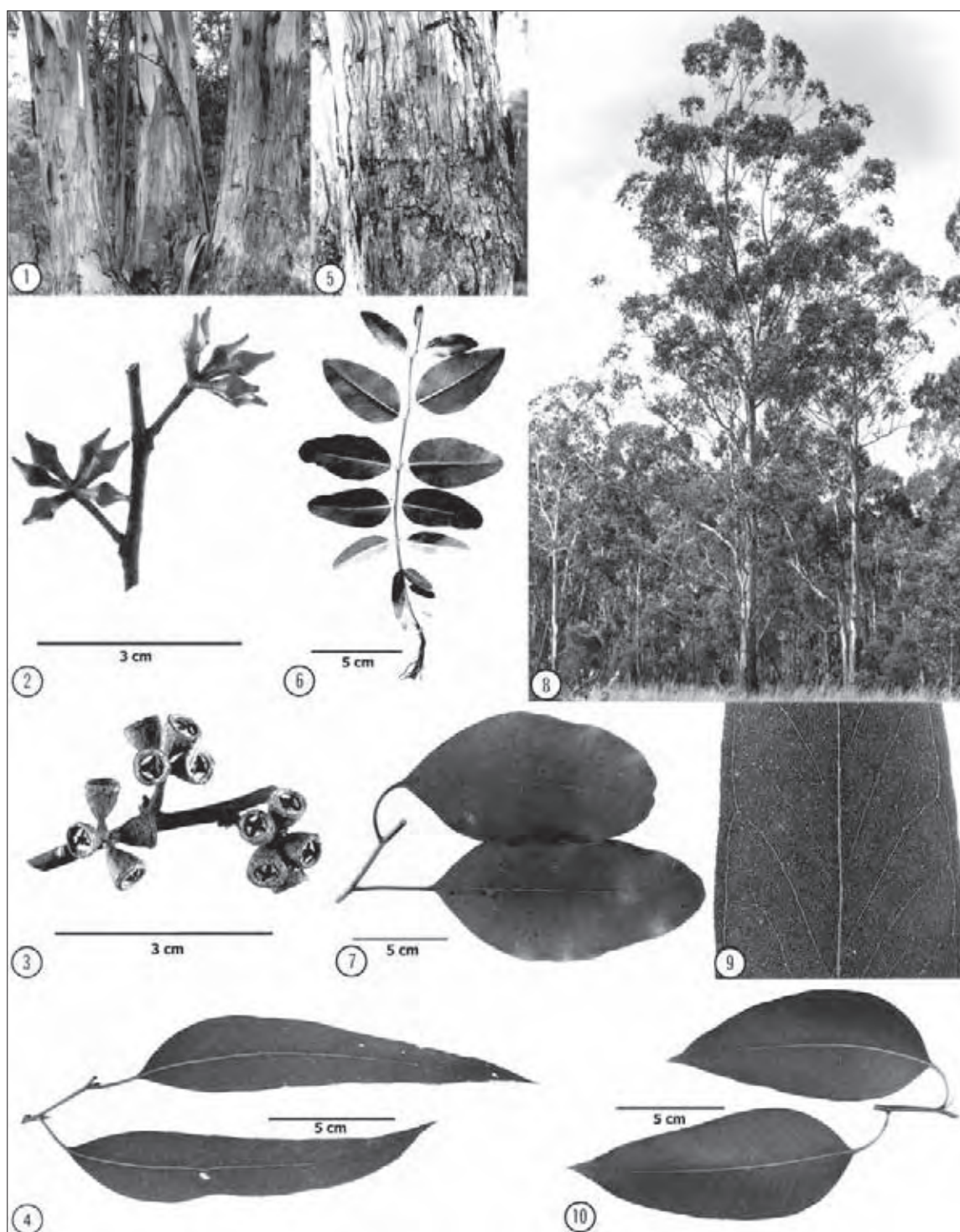
Inflorescences: Simple, axillary, 7-flowered; peduncles more or less terete to angular, 0.3–1.4 cm long; pedicels absent or 0.1–0.4 cm long; buds ovoid or diamond-shaped, 0.7–1.1 × 0.4–0.6 cm; opercula conical or slightly rostrate, rarely hemispherical-apiculate. Flowers Mar.–Jun.

Fruits: Sessile or shortly pedicellate, obconical, 0.5–0.7 × 0.4–0.7 cm; disc relatively broad, annular, more or less level; valves 3 or 4, short, broad, more or less horizontal, about rim level, occasionally slightly below, rarely exserted; often with a skin (pellicle) partially covering the valves. Seeds flattened-elliptical, grey-brown-black, hilum ventral.

Wood: Heartwood, pale with pinkish tinge, not very durable; density 530–820(680) kg m⁻³; not utilised extensively though sawn occasionally in Victoria and used for local farm requirements.

Climate: Altitudinal range: near sea level to 1100 m; Hottest/coldest months: 19–27°C/–1–6°C; Frost incidence: low to high (up to 70 or more each year and snow at high elevations); Rainfall: 570–1650 mm per year, winter max. to uniform.

Distinctive features: A gum, usually of swampy areas, often with a short basal stocking of rough bark; intermediate and adult leaves ovate, glossy, undulate, usually glandless in the typical form; 7-flowered inflorescences; diamond-shaped buds; obconical fruits.



Eucalyptus ovata 1, 5. Bark 2. Buds 3. Fruits 4. Adult leaves 6. Seedling 7. Juvenile leaves 8. Tree, Naghi State Forest, south of Eden, N.S.W. 9. Adult leaf venation 10. Intermediate leaves

Brooker's Gum

Eucalyptus brookeriana A.M. Gray

Brooker's gum is a medium-sized to tall forest tree of erect habit 10–40 m in height with dbh up to about 1 m. Crowns typically have a rather open appearance with clusters of leaves carried towards the ends of generally steeply angled branches.

Brooker's gum occurs principally in Tasmania, from Tower Hill in the north-east to Kelleve in the south-east, and in the west near Zeehan, Corinna and Lake Pedder and the Arthur River area in the north-west. Since its original publication in 1979 this species (thought to be *E. ovata* Labill. for many years), has been found also on King Island, and in Victoria on the plateau between Daylesford and Woodend.

This species occurs on well-drained rocky soils on slopes and ridge tops or on alluvial deposits adjacent to small streams. It grows in tall open forests (often on the fringe of or within rainforest), or in open forests.

Associated eucalypt species include black peppermint (*E. amygdalina*), mountain gum (*E. dalrympleana*), alpine ash (*E. delegatensis*), messmate stringybark (*E. obliqua*), mountain ash (*E. regnans*), silvertop ash (*E. sieberi*), manna gum (*E. viminalis*) and Smithton peppermint (*E. nitida*). In the Arthur River area in the north-west it may occur as the only eucalypt in beech forest (*Nothofagus cunninghamii*).

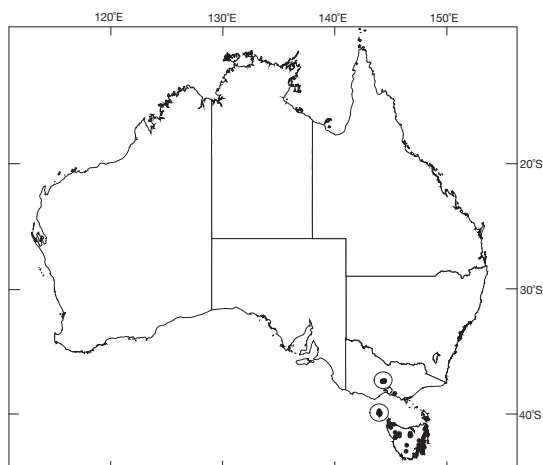
Related species: Because of its affinity with swamp gum (*E. ovata*), this species was placed in series *Foveolatae* with other swamp gum species (Brooker 2000). Barber's gum (*E. barberi*), a Tasmanian endemic, differs in having smaller, smooth-edged juvenile leaves, concolorous adult leaves, with fewer oil glands and larger fruits. In addition *E. barberi* is, at best, a small tree but more commonly a mallee. Swamp gum (*E. ovata*), to which collections of Brooker's gum have been ascribed for many years, differs in habitat, habit, canopy structure, seedling morphology and leaf oil constituents (q.v.). Further study of the swamp gum group is required to resolve the taxonomic differences among taxa.

Publication: *Aust. For. Res.* 9, 111(1979). Type: Near Rocka Rivulet, c. 25 km north-west of Little Swanport, Tasmania, 16 Feb. 1977, A.M. Gray 225.

Names: Both botanical and common honour M.I.H. Brooker (b. 1934 extant), a CSIRO eucalypt taxonomist with the then Division of Forest Research, later with CSIRO Plant Industry and recently CSIRO Forestry and Forest Products.

Bark: Finely fibrous, grey, shallowly and regularly fissured, for 1–6 m, often distinctly tessellated, decorticating above in strips or elongated flakes, the freshly exposed areas dull orange-red to olive-green with cream blotches.

Leaves: Seedling—opposite for 4–6 pairs then alternate, petiolate, ovate to broadly elliptical, 3.5–7.5 × 2–4 cm, crenulate, green, discolorous. Juvenile—alternate, petiolate, broadly ovate or occasionally more or less orbicular, 6–14 × 3–8 cm, crenulate, green, discolorous. Seedling and juvenile stems are red, distinctly quadrangular in cross-section and have numerous raised oil glands. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 8–17 × 3–6 cm,



often undulate and usually with crenulate margins, green, discolorous. Adult—alternate, petiolate, broad-lanceolate to lanceolate, 6.5–15 × 1.5–2.5 cm, often undulate, usually with crenulate margins, green, discolorous in forms in eastern Tasmania, more or less concolorous in western forms in Tasmania and in Victoria.

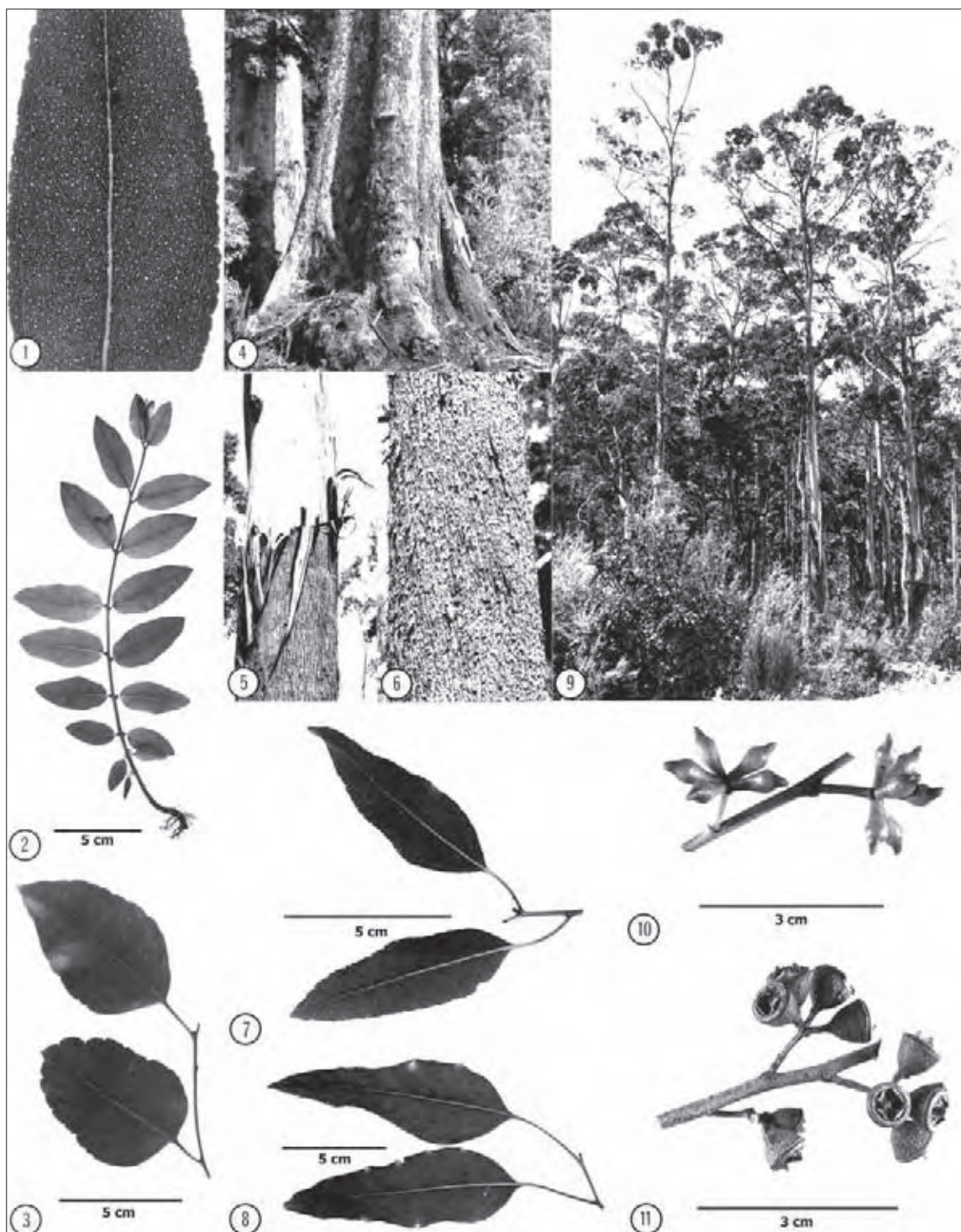
Inflorescences: Simple, axillary, 7(9)-flowered; peduncles angular, 0.5–1.2 cm long; pedicels 0.1–0.5 cm long; buds more or less diamond-shaped, 0.7–1 × 0.4–0.5 cm; opercula hemispherical-apiculate to rostrate. Flowers Nov.–Mar.

Fruits: Pedicellate, obconical, cupular or more or less hemispherical, 0.5–0.8 × 0.5–0.7 cm; disc narrow, more or less level to ascending; valves 3 or 4, short, erect, about rim level or exserted. Seeds flattened-elliptical, black, hilum ventral.

Wood: Heartwood straw-coloured to pale brown, pinkish towards the centre, with moderately well-developed growth rings, has the general characteristics of ash-type eucalypts; density about 800 kg m⁻³; probably not used commercially.

Climate: Altitudinal range: 50–750 m; Hottest/coldest months: 18–23°C/1–4°C; Frost incidence: low to high (5–30 each year and snow at high elevations); Rainfall: 700–2450 mm per year, winter max.

Distinctive features: A medium-sized to tall forest tree, largely smooth-barked but with a distinct, often tessellated basal stocking; leaves at all stages discolorous in eastern Tasmania and usually with crenulate margins, particularly the juvenile leaves; adult leaves often undulate; inflorescences axillary, mostly 7-flowered; opercula hemispherical-apiculate or rostrate.



Eucalyptus brookeriana 1. Adult leaf venation 2. Seedling 3. Juvenile leaves 4. Lower bark 5. Transition between lower rough bark and upper smooth bark 6. Lower bark 7. Adult leaves 8. Intermediate leaves 9. Stand, Rocka Rivulet, north-west of Little Swanport, Tas. 10. Buds 11. Fruits

Brittle Gum Red Spotted Gum

Eucalyptus mannifera Mudie

Brittle gum is a small to moderate-sized tree, usually within the limits of 15–25 m in height and 30–60 cm dbh, but on adverse sites it may be smaller and of poor form. The trunk is usually moderately straight and up to half the total tree height before it divides to form an open, medium-sized crown. There are two subspecies, the typical and subsp. *gullickii*.

The typical subspecies is found on the western side of the Central Tablelands of New South Wales, south from Bathurst through the Southern Tablelands and mountains to eastern Victoria, e.g. Mt Timbertop, Paradise Falls, Mt Buffalo and Bonang. Subsp. *gullickii* occurs in the Central Tablelands, e.g. the Megalong Valley, Katoomba and Mt Wilson, south through the eastern part of the Southern Tablelands, e.g. Deua National Park east of Braidwood, but not in Victoria.

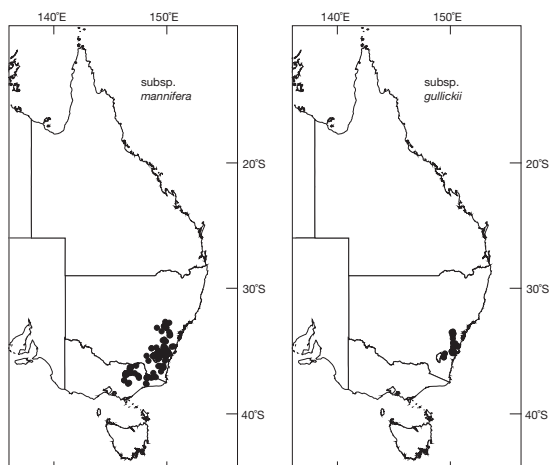
Subsp. *mannifera* grows on a wide range of topography but is most common on the skeletal soils of plateaux and hill slopes where the parent rocks are Triassic and Permian sandstones. Subsp. *gullickii* is usually found in swamps in cold sites where high altitude springs and bogs form the sources of small streams on the gentle to rolling topography of tablelands.

Brittle gums are usually woodland species. Species commonly associated with subsp. *mannifera* include candlebark (*E. rubida*), scribbly gum (*E. rossii*), red stringybark (*E. macrorhyncha*), red box (*E. polyanthemus*), yellow box (*E. melliodora*); and with subsp. *gullickii*, silvertop ash (*E. sieberi*), narrow-leaved peppermint (*E. radiata*), snow gum (*E. pauciflora*), *Banksia* spp. and tea tree (*Leptospermum* spp.).

Related species: Brittle gum belongs to a small group of white gums that constitute series *Microcarpae* Blakely (Brooker 2000). It is replaced by related brittle gum species, *E. elliptica* and *E. praecox* in the Northern Tablelands of New South Wales. These two species of similar appearance to brittle gum are easily distinguished by the broadly elliptical juvenile leaves, compared with narrow juvenile leaves of typical brittle gum, which are conspicuous in the field in areas of regrowth. Subsp. *gullickii* has similar juvenile leaves to *E. praecox* which is not an inhabitant of wet sites. Brittle gum is often confused as a tree in the Southern Tablelands of New South Wales (e.g. in the Canberra region) with a common associate, scribbly gum (*E. rossii*), which belongs to another subgenus and is readily recognised by the insect scribbles on the non-powdery bark.

Publication: Subsp. *mannifera*: *Trans. Roy. Med-Bot. Soc. London* 1, 24 (1834). Type: Bathurst, New South Wales, Jan. 1925, A. Cunningham 91. Subsp. *gullickii* (R.T. Baker & H.G. Smith) L.A.S. Johnson: *Contr. New South Wales Natl. Herb.* 3, 108 (1962). Type: Lawson, New South Wales, Aug. 1919, C.F. Laseyron.

Names: Botanical—Latin *mannifera* (manna-bearing), probably refers to an exudate from the tree, although this is not a prominent feature of this species; *gullickii*: after W.A. Gullick (1859–1922) Government Printer of New South Wales, who printed a number of publications on eucalypts. Common—alludes to the brittle nature of the wood.



Bark: Smooth, decorticating to near ground level, white or pink, powdery, some rough bark rarely retained to form a small stocking.

Leaves: Seedling—opposite for 4–6 pairs, shortly petiolate, slightly pruinose, linear to lanceolate, 4–9.5 × 0.3–2.3 cm, green to grey-green, very slightly discolorous. Juvenile—opposite for few pairs then subopposite, shortly petiolate, linear to narrow-lanceolate and often curved, 4–10 × 0.5–1.8 cm (*mannifera*) or elliptical to ovate, 3–9.5 × 1.4–3 cm (*gullickii*), bluish green to blue-grey, concolorous. Intermediate—alternate, petiolate, lanceolate or slightly falcate, 10–15 × 2–3 cm, bluish green to blue-grey, concolorous. Adult—alternate, petiolate, lanceolate or falcate, 7–18.5 × 1–3 cm, bluish green or blue-grey, concolorous.

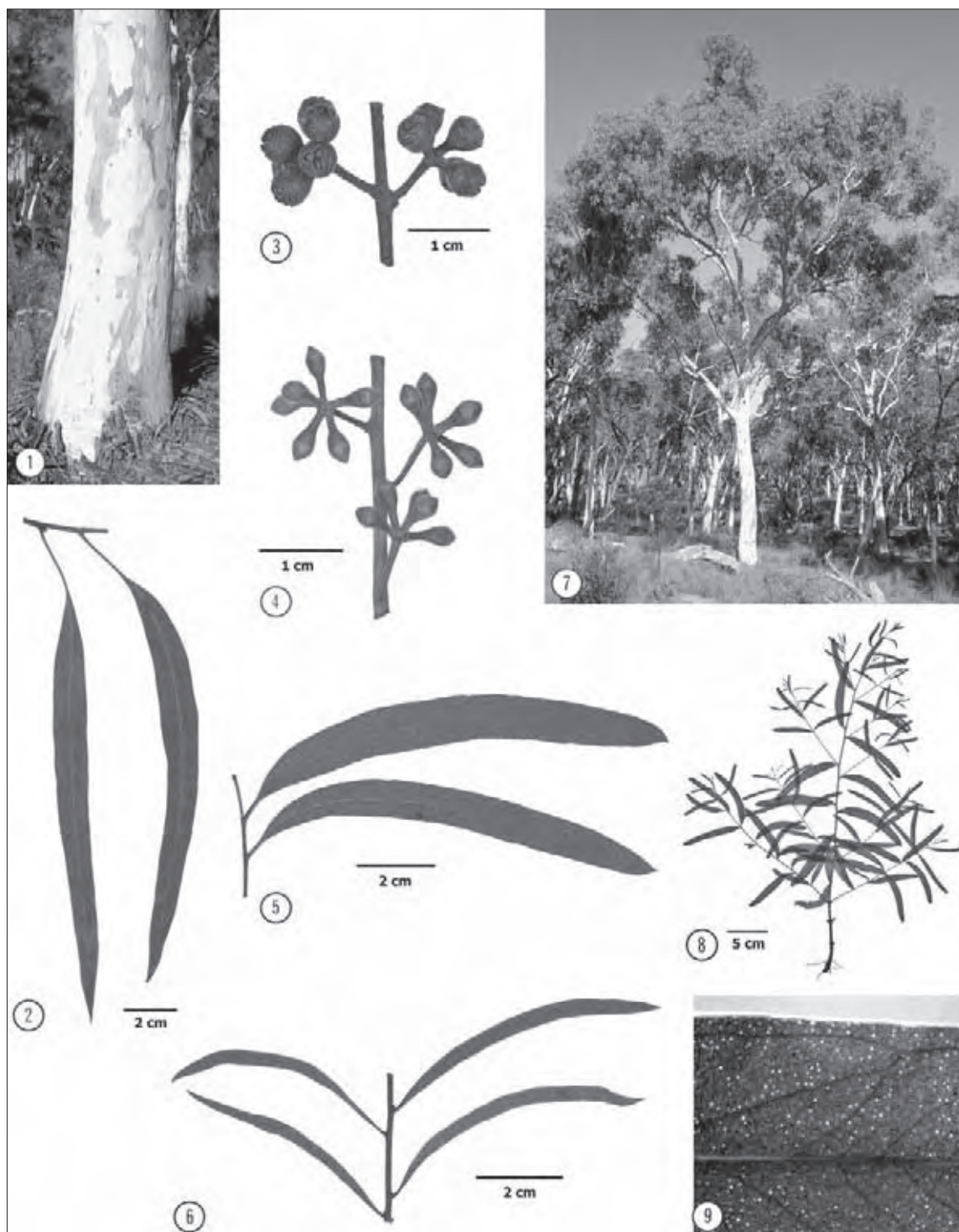
Inflorescences: Simple, axillary, 7-flowered; peduncles up to 1 cm long, pedicellate; more or less ovoid or clavate, c. 0.5 × 0.3 cm; opercula conical or hemispherical. Flowers Aug.–Dec.

Fruits: Hemispherical, 0.4 × 0.7 cm; pedicels may be inconspicuous. Disc somewhat narrow, more or less flat to slightly convex; valves 3(4), very slightly exerted. Seeds flattened-elliptical, grey-brown, hilum ventral.

Wood: Heartwood reddish, moderately heavy, hard, close-grained, only moderately durable and very brittle; density 870 kg m⁻³; has restricted use as firewood.

Climate: Altitudinal range: 100–1160 m; Hottest/coldest months: 21–28°C/–3–4°C; Frost incidence: moderate to high (snow and severe frosts during winter at high elevations); Rainfall: 600–1600 mm per year, winter max. to uniform.

Distinctive features: A small to medium-sized tree of hilly sites (*mannifera*), of swamps (*gullickii*), with a white, smooth bark; juvenile leaves linear to narrow-lanceolate (*mannifera*), elliptical (*gullickii*), dull bluish green or blue-grey; inflorescences 7-flowered; fruit small, to 0.7 cm diameter with 3 slightly exerted valves.



Eucalyptus mannifera 1. Bark 2. Adult leaves 3. Fruits 4. Buds 5. Intermediate leaves 6. Juvenile leaves (subsp. *mannifera*) 7. Tree, near Canberra, A.C.T. 8. Seedling (subsp. *mannifera*) 9. Adult leaf venation

Camden Woollybutt Paddys River Box

Eucalyptus macarthurii Deane & Maiden

Camden woollybutt on favourable sites attains 40 m in height, with dbh up to 1.2 m and a straight but often heavily branched bole. On less favourable sites it is commonly 18–25 m high and, if in open formation, may retain large branches from near ground level although the main stem may be comparatively straight.

Camden woollybutt has a restricted natural occurrence in the Central and Southern Tablelands of New South Wales from the southern Blue Mountains to Goulburn. It can be readily observed occurring in pure stands along Paddys River just north of Marulan and in Penrose State Forest.

Camden woollybutt is usually found on flats and near swamps and streams in country of moderate relief. It prefers fertile clay loams and alluvials, which retain a suitable soil moisture level throughout the year, but it will also show good growth on deep sandy loams over clay and, as a smaller tree, it is found on lighter sandy loams.

On the better quality sites this eucalypt may be the main species over small areas but elsewhere it is usually only a minor constituent of mixed open forests. Associated eucalypts include narrow-leaved peppermint (*E. radiata*), broad-leaved peppermint (*E. dives*), snow gum (*E. pauciflora*), manna gum (*E. viminalis*) and mountain gum (*E. dalrympleana*).

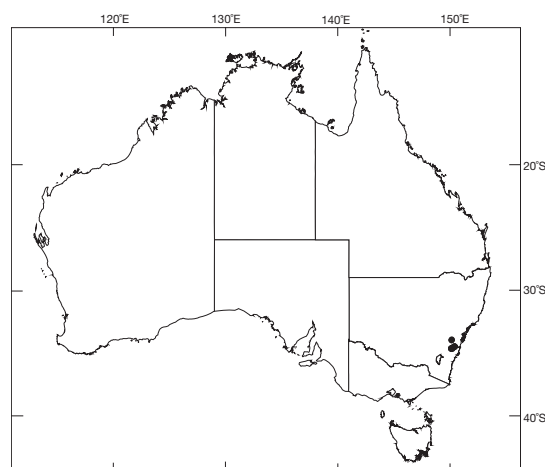
Related species: Camden woollybutt is not obviously related to any other single species and was placed by Brooker (2000) with the typical swamp gums in series *Foveolatae* as it is 7-flowered and inhabits wet areas. It differs from the other species in the series by the prominent, opposite, moderately large bluish juvenile leaves. It resembles some forms of the 3-flowered *E. viminalis*, particularly in the ribbony bark, although Camden woollybutt has much more rough bark. Another 7-flowered species is gully gum (*E. smithii*), which is distinguished by the distinct compact basal bark, larger fruits with a steep disc and occurs in gullies and more rugged situations.

Publication: *Proc. Linn. Soc. N.S.W.* 24, 448 (1899). Type: Vicinity of Berrima, New South Wales, 1854, W. Macarthur (No. 142).

Names: Botanical—after W. Macarthur (1800–1882), the collector of the type. Common—probably refers to the Camden area (although it is not common in this area) and to the bark.

Bark: Rough and persistent on the trunk and larger branches, coarsely fibrous, becoming deeply fissured at the base of large trees, ribbony, greyish brown, smooth, greyish on smaller limbs.

Leaves: Seedling—opposite, sessile, amplexicaul, ovate, 3–5 × 2.3–4.7 cm, green, discolorous. Juvenile—opposite, sessile, amplexicaul, ovate to almost orbicular, 5–7.5 × 2.5–5.5 cm, bluish green, discolorous. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 10–19 × 1.6–3 cm, green, concolorous. Adult—alternate,



petiolate, narrow-lanceolate or falcate, 8.5–19 × 0.8–1.6 cm, green, concolorous.

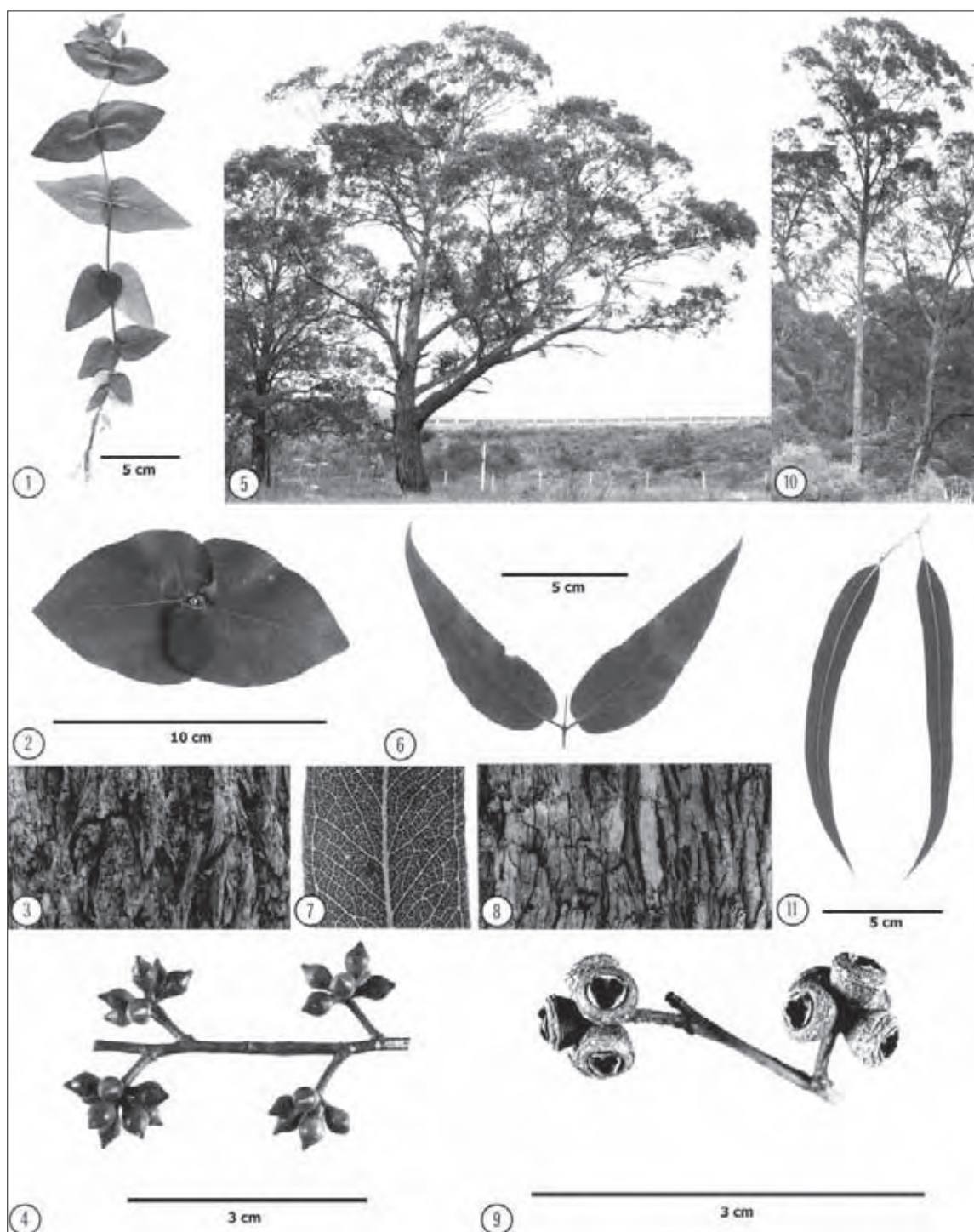
Inflorescences: Simple, axillary, 7-flowered; peduncles angular, 0.2–0.9 cm long; pedicels sometimes absent, but more usually 0.05–0.3 cm long; buds 0.3–0.5 × 0.2–0.3 cm; hypanthia obconical; opercula conical or hemispherical-apiculate. Flowers Feb.–Apr.

Fruits: Shortly pedicellate or occasionally sessile, hemispherical or broadly obconical, 0.3–0.5 × 0.35–0.6 cm; disc broad, ascending; valves 3(4), slightly exserted. Seeds flattened-ellipsoidal, grey-black, hilum ventral.

Wood: Heartwood pale coloured, nearly white, moderately heavy, does not split readily and not of high durability in the ground; density around 640 kg m⁻³; used on farms to a limited extent but not highly regarded.

Climate: Altitudinal range: 400–1200 m; Hottest/coldest months: 25–28°C/–1–3°C; Frost incidence: high (30 to over 100 each year at high elevations); Rainfall: 800–1100 mm per year, uniform.

Distinctive features: A medium-sized to tall, coarsely fibrous-barked tree; juvenile leaves opposite and sessile for many pairs, ovate, amplexicaul, bluish green; adult leaves narrow-lanceolate; small, broadly obconical fruits; prefers poorly drained sites. The foliage is rich in geraniol and has been distilled to yield an oil used in perfumery.



Eucalyptus macarthurii 1. Seedling 2. Juvenile leaves 3, 8. Bark 4. Buds 5, 10. Trees, Paddys River, north-east of Marulan, N.S.W. 6. Late juvenile/intermediate transition leaves 7. Adult leaf venation 9. Fruits 11. Adult leaves

Camden White Gum Nepean River Gum

Eucalyptus benthamii Maiden et Cambage

Camden white gum is a moderately tall tree, attaining heights of 25–35 m and a dbh of 1–1.5 m. In open situations the trunk usually divides at quarter to half the tree height to form a large and moderately dense crown with numerous, very fine ultimate branchlets.

This species has a limited distribution in eastern coastal New South Wales. The main occurrence is south-west of Sydney on the flats of the Nepean River and its tributaries, especially those that have been submerged under the waters of the Warragamba Dam. The original area was probably 100 km long and 40 km wide. Recent estimates indicate that approximately 6000 trees occur in the Kedumba Valley, 300 trees at Bents Basin, and 40 trees in remnant populations near Camden and Wallacia. Much of the original habitat in the Camden area has been cleared for cropping or improved pasture, so that little of the original vegetation now remains.

This species prefers river banks, river flats or the gentle slopes of adjacent low-lying country. The soils are mainly loamy alluvials of good agricultural quality, often with clay at a depth of 0.5–1 m.

Camden white gum grows in open or tall open forests either in pure stands or associated with eucalypts such as round-leaved gum (*E. deanei*) and river peppermint (*E. elata*). Nearby there may be forest red gum (*E. tereticornis*) or grey box (*E. moluccana*).

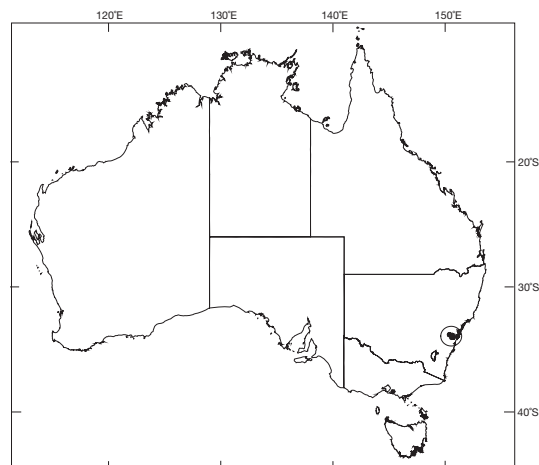
Related species: Brooker (2000) placed Camden white gum in the series *Benthamianae* and considered it not obviously closely related to any other species. It is a species usually associated with rivers where it can form stands of tall, mainly smooth, white-barked trees with a short basal stocking of rough bark. The juvenile leaves are conspicuous, being ovate and bluish green. The buds have the rare character of an imperfectly shed outer operculum, which comes off in small flakes leaving a squarish exposed tip of the bud. In most *Maidenaria* species, the outer operculum sheds early in bud development leaving a distinct median scar. *E. benthamii* var. *dorrigoensis* Blakely of restricted occurrence on the Dorrigo Plateau, whose relationship to Camden white gum is now rejected, was raised to species status as *E. dorrigoensis* by Johnson and Hill (1990). It does not share the operculum character with Camden white gum. Progeny arrays containing putative *E. benthamii* × *E. viminalis* hybrids were documented by Butcher *et al.* (2005)

Publication: J. & Proc. Roy. Soc. New South Wales 48, 418 (1915). Type: Nepean River, near Cobbity, New South Wales, June 1913, J.H. Maiden & R.H. Cambage.

Name: Botanical—honours George Bentham (1800–1884) the English author of *Flora Australiensis* (1863–78).

Bark: Smooth, decorticating in long, thin ribbons, except for a short stocking to 2–3 m, to leave a smooth, whitish surface. The persistent rough bark is thin, compact and tends to form small longitudinal strips, which may be only partly adherent.

Leaves: Seedling—opposite, sessile, the first 2–4 pairs elliptical to ovate, 1.5 × 0.5 cm, then broadly ovate, 2.5–5 × 1.5–3.5 cm, amplexicaul, discolorous. Juvenile—



opposite, sessile, broadly oblong-ovate to elliptical, 3–9 × 2–4 cm, base amplexicaul to rounded, bluish green, concolorous. Intermediate—opposite to subopposite, sessile to shortly petiolate, lanceolate, concolorous. Adult—alternate, petiole to 3.5 cm long, lanceolate, 8–23 × 1.2–2.7 cm, dull to very slightly glossy, light green to slightly bluish green, thin, concolorous.

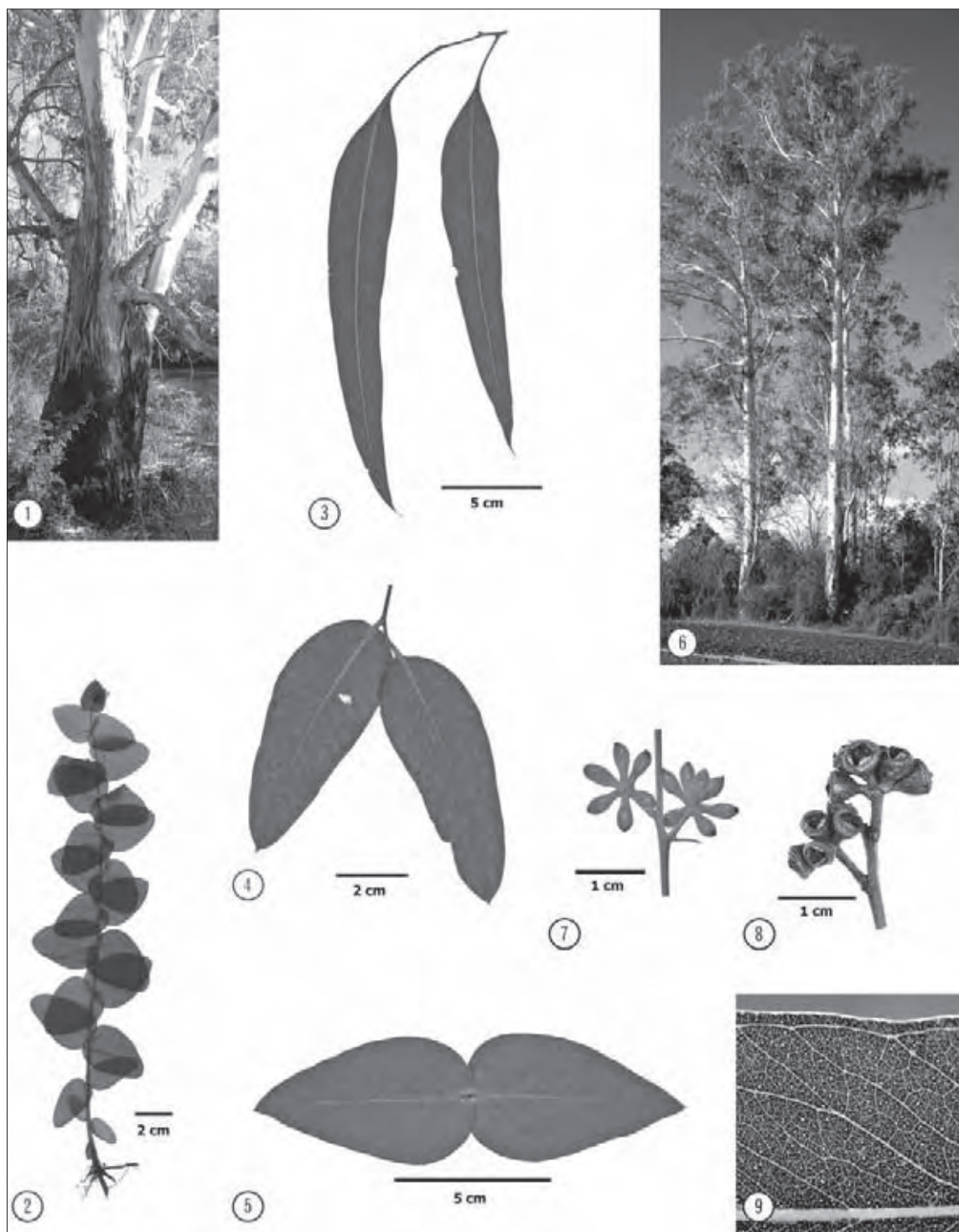
Inflorescences: Simple, axillary, 7-flowered; peduncles terete to 0.8 cm long; shortly pedicellate; buds ovoid to clavate, c. 0.5 × 0.3 cm, often pruinose.

Fruits: Hemispherical to campanulate, 0.3–0.5 × 0.4–0.6 cm; slightly pruinose when immature; disc narrow, slightly convex or more or less level, the valves 3 or 4, shortly exserted. Seeds flattened-elliptical, black, shallowly reticulate, hilum ventral.

Wood: Fissile and moderately durable; 13-year-old trees cultivated near Canberra had a basic density of 500 kg m⁻³, were short-fibred and not considered suitable for pulpwood. Supply is negligible from natural stands.

Climate: Altitudinal range: 60–230 m; Hottest/coldest months: 27–29°C/2–3°C; Frost incidence: moderate; Rainfall: 750–850 mm per year, summer max.

Distinctive features: A moderately tall gum favouring riverine sites. The juvenile leaves, buds and immature fruit are somewhat pruinose, while the intermediate and adult leaves are green and moderately thin; buds and fruit small, with short peduncles and very short pedicels.



Eucalyptus benthamii 1. Bark 2. Seedling 3. Adult leaves 4. Intermediate leaves 5. Juvenile leaves 6. Trees, near Bents Basin, Nepean Rivert, N.S.W. 7. Buds 8. Fruits 9. Adult leaf venation

Dunn's White Gum White Gum

Eucalyptus dunnii Maiden

Dunn's white gum attains heights of 50 m and dbh of 1–1.5 m (occasionally 2.5 m), with clear stems up to 30–35 m. In more open-grown conditions the crown is wide spreading and heavily branched.

This species has a restricted, disjunct natural occurrence in north-eastern New South Wales and far south-eastern Queensland. The southern disjunct occurrence is west of Coffs Harbour in the Moleton and Clouds Creek area of New South Wales, while a northern occurrence extends north from Legume and Urbenville to the McPherson Range on the New South Wales–Queensland border to Mount Mitchell in the high country south-east of Boonah in Queensland.

Dunn's white gum is mainly found in valley bottoms and on the lower slopes of hills and escarpments, but also grows high on ridges in basaltic soils around the edges of rainforest. This species prefers moist, highly fertile soils, particularly those of basaltic origin, but will also grow on those derived from sedimentary rocks, especially the more freely drained shales.

Dunn's white gum is a species of tall open forests, its most common associated species being Sydney blue gum (*E. saligna*), tallowwood (*E. microcorys*), flooded gum (*E. grandis*), grey gum (*E. propinqua*), cabbage gum (*E. amplifolia* subsp. *sessiliflora*) and forest oak (*Allocasuarina torulosa*).

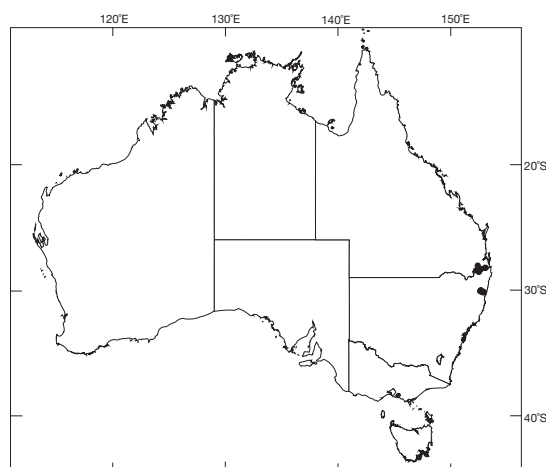
Related species: Brooker (2000) placed Dunn's white gum in the apple box series *Bridgesianae*, the best-known species being the much more widespread apple box (*E. bridgesiana*). Within this series it is easily distinguished by the tall tree habit and the smooth bark, apart from a rough basal stocking. It may be associated in the field with the unrelated Sydney blue gum (*E. saligna*) and flooded gum (*E. grandis*), which differ by the distinctly petiolate, entire juvenile leaves and the discoloured adult leaves, compared with the almost sessile, crenulate juvenile leaves and concolorous adult leaves of the apple boxes (apart from *E. angophoroides*).

Publication: *J. Linn. Soc. N.S.W.* 30, 336 (1905). Type: Acacia Creek, McPherson Range, New South Wales, 8 May 1905, W. Dunn 88.

Names: Botanical—honours W. Dunn (1860–fl. 1921), Forest Guard with the Forest Service of New South Wales, who collected the type material. Common—also refers to Dunn and to the bark of the species.

Bark: Rough, brownish, flaky and more or less corky at the base for 1–4 m, smooth, whitish above with bluish grey patches, commonly with long ribbons of decorticated bark hanging from branches.

Leaves: Seedling—opposite to subopposite, shortly but distinctly petiolate, ovate to orbicular, or cordate, crenulate, 5–7.5 × 3–5 cm, green, strongly discoloured. Juvenile—opposite or slightly alternate, petiolate, ovate to more or less orbicular, or cordate, crenulate, 5.5–12 × 4–7.5 cm, green, strongly discoloured. Intermediate—alternate, petiolate, lanceolate, 20–30 × 3–5 cm, green, slightly discoloured or



concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 13–20 × 1.3–2.5 cm, green, concolorous.

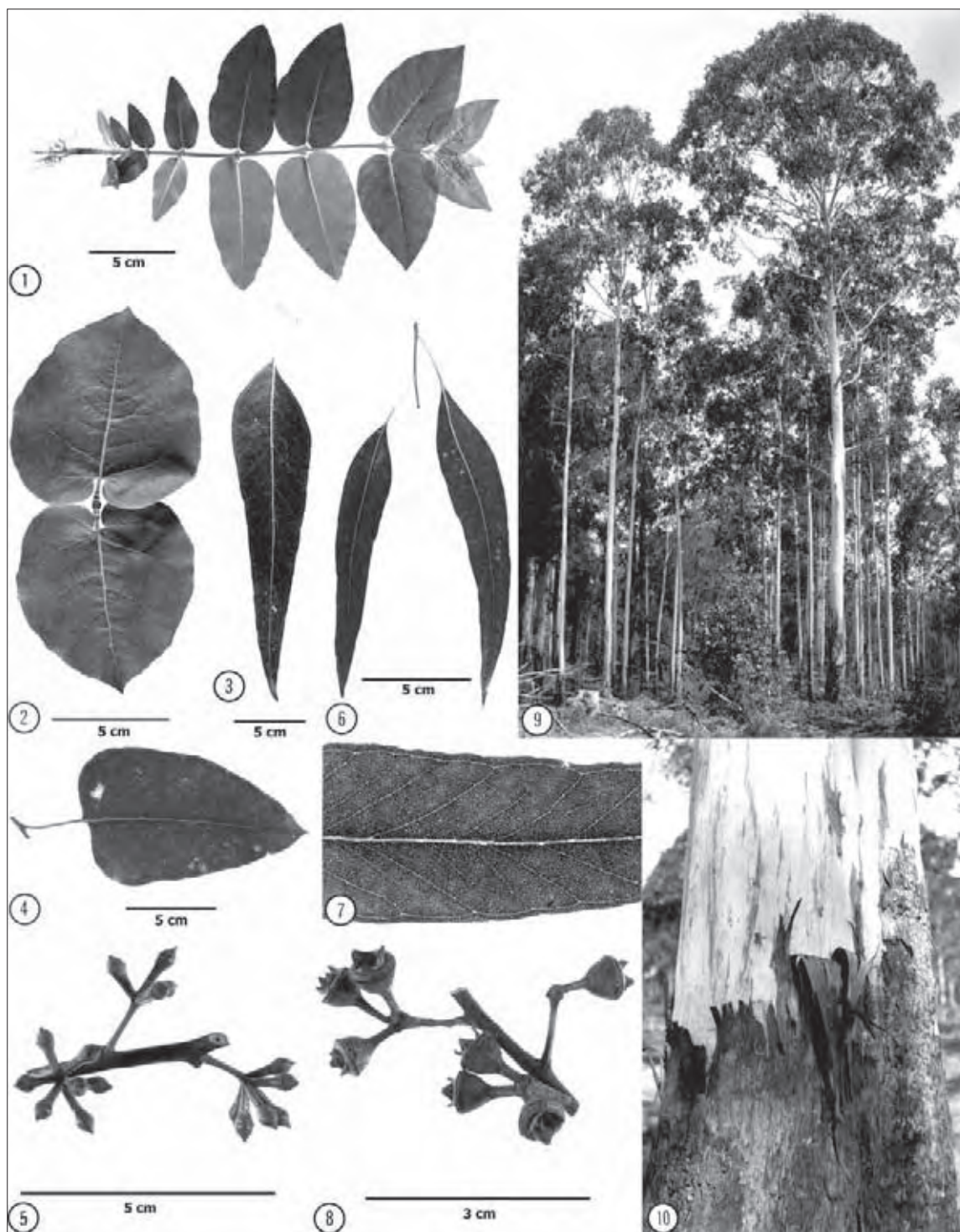
Inflorescences: Simple, axillary, 7-flowered; peduncles flattened, 0.7–1.5 cm long; pedicels angular, 0.1–0.5 cm long; buds ovoid, 0.5–0.7 × 0.3–0.5 cm; opercula conical, hemispherical and apiculate or slightly rostrate. Flowers Mar.–May.

Fruits: Pedicellate, more or less hemispherical, 0.4–0.5 × 0.5–0.8 cm; disc broad, more or less level or ascending; valves 3 or 4, deltoid, very broad-based, exserted, sometimes outward-curved, usually with remnants of a skin (pellicle). Seeds flattened-ellipsoidal, grey-brown, hilum ventral.

Wood: Sapwood susceptible to *Lyctus* borer attack; heartwood whitish, yellowish brown to pale brown, tough, coarse-grained, fissile, of low durability; density about 800 kg m⁻³; used for light construction purposes and veneer; currently in demand overseas for pulp. Wood similar to Tasmanian blue gum (*E. globulus*).

Climate: Altitudinal range: 220–860 m; Hottest/coldest months: 24–29°C/2–5°C; Frost incidence: moderate (about 20–60 each year during winter); Rainfall: 1000–1600 mm per year, summer max.

Distinctive features: A tall, almost completely smooth-barked tree of good quality eucalypt forest; juvenile leaves petiolate, orbicular to ovate, crenulate, strongly discoloured; intermediate leaves to 30 cm long.



Eucalyptus dunnii 1. Seedling 2. Early juvenile leaves 3. Intermediate leaf 4. Later juvenile leaf 5. Buds 6. Adult leaves 7. Adult leaf venation 8. Fruits 9. Stand, Moleton area, north-west of Coffs Harbour, N.S.W. 10. Bark

Apple-topped Box

Eucalyptus angophoroides R.T. Baker

Apple-topped box is usually a medium-sized to tall tree up to 30 m in height, but may attain 40 m with 1 m dbh. The trunk is typically straight and retains its dominance to about two-thirds of the total height and is of good form on all but the poorest sites.

Apple-topped box grows in small, scattered communities in south-eastern New South Wales from about the Marulan–Bowral district southwards into eastern Victoria where it extends westwards as far as the Strzelecki Range (south Gippsland area). Most of the occurrences are within 50 km of the coast.

This species grows in lowland valleys and on lower hill slopes between the sea and the steeper topography of the coastal escarpment. The soils are mainly sedimentary and alluvial, especially near the edges of swamps where the sites are not inundated except during severe storms.

Apple-topped box occurs in open eucalypt forests and is rarely abundant. It may be associated with blue box (*E. baueriana*), coast grey box (*E. bosistoana*), river peppermint (*E. elata*), manna gum (*E. viminalis*), mountain grey gum (*E. cypellocarpa*), swamp gum (*E. ovata*), messmate (*E. obliqua*) and rough-barked apple (*Angophora floribunda*).

Related species: Brooker (2000) placed apple-topped box in the apple box group (series *Bridgesianae*), the best-known species being the much more widespread apple box (*E. bridgesiana*), which occurs from far south-eastern Queensland to eastern Victoria. *E. angophoroides* is the taller coastal form of apple box which is a woodland tree of the tablelands. The juvenile leaves of apple-topped box are green (pruinose in *E. bridgesiana*), the adult leaves are discolorous and the fruit are 4-valved (3-valved in *E. bridgesiana*).

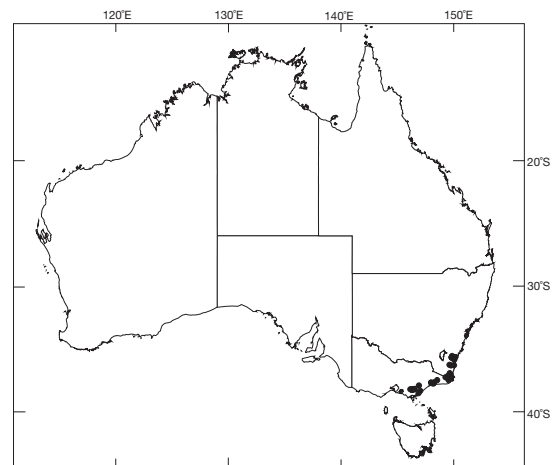
Publication: *Proc. Linn. Soc. N.S.W.* 25, 676 (1900). Type: Colombo, W. Baeuerlen and Towrang, R.T. Baker, New South Wales.

Names: Botanical and common both refer to a (superficial) resemblance of this species to rough-barked apple (*Angophora floribunda*).

Bark: Rough and persistent on the trunk and large branches but shed to a variable degree from the smaller branches, box-type, light to medium grey or grey-brown, short-fibred, with somewhat shallow, transverse fissures resulting in a somewhat tessellated appearance.

Leaves: Seedling—opposite for many nodes, sessile or very shortly petiolate, cordate, crenulate, 3–7 × 2–4 cm, green, strongly discolorous. Juvenile—opposite or subopposite, shortly petiolate, cordate, crenulate, 4–9 × 4–7 cm, green, strongly discolorous. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 10–24 × 2.5–5 cm, green, discolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 8–23 × 1.8–2.5 cm, green, discolorous.

Inflorescences: Simple, axillary, 7-flowered; peduncles angular to flattened, 0.5–1 cm long; pedicels 0.1–0.6 cm long;



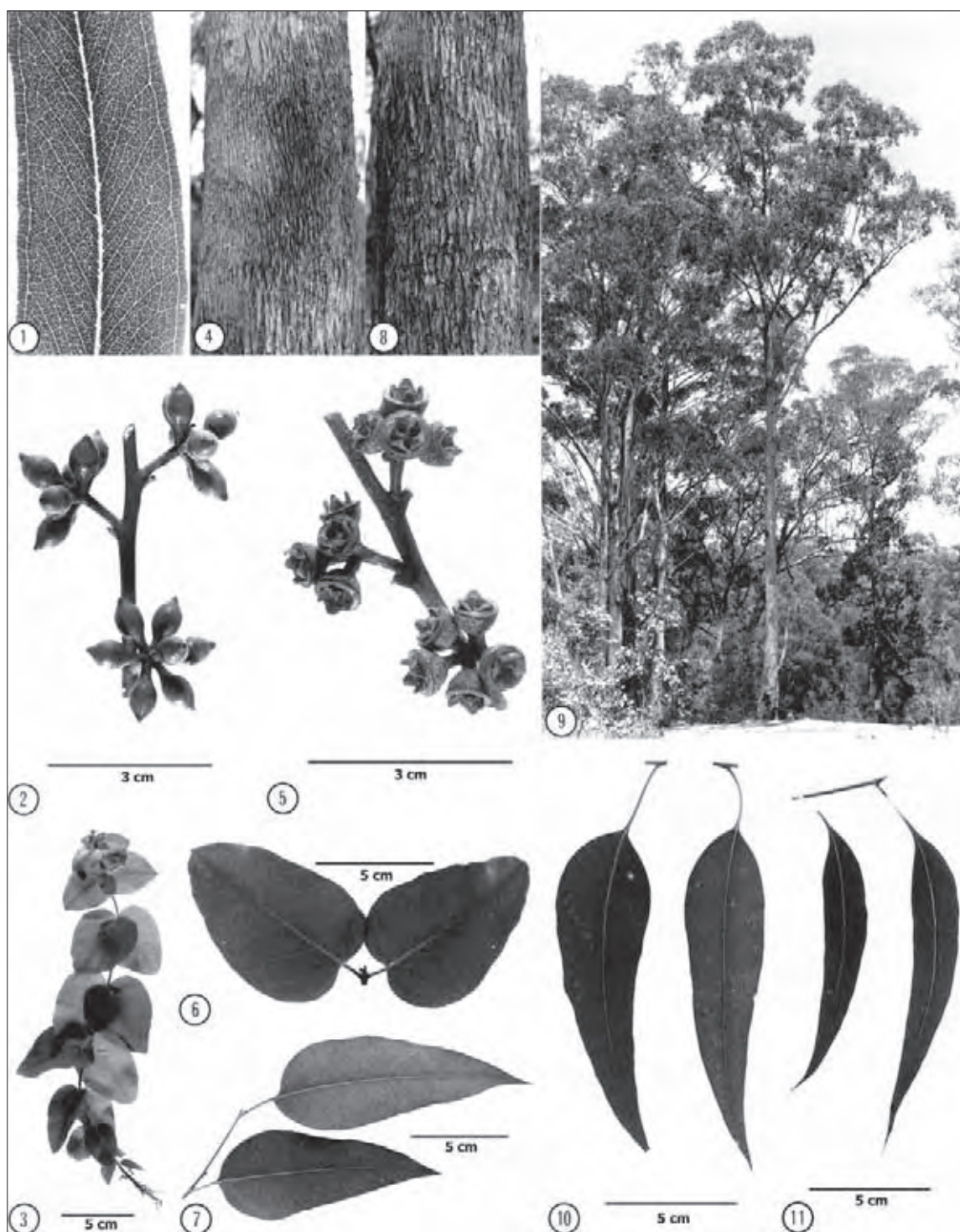
buds ovoid, 0.4–0.7 × 0.3–0.5 cm; opercula hemispherical-apiculate or conical. Flowers Oct.–Dec.

Fruits: Pedicellate, hemispherical, 0.4–0.5 × 0.6–0.7 cm; disc medium width, more or less level; valves usually 4, short, broad, exserted. Seeds flattened-ellipsoidal, dark brown, hilum ventral.

Wood: Heartwood pale brown, soft, seasons well and has some resemblance to that of *Angophora floribunda*; density not known but probably similar to its close relative *E. bridgesiana* which is 670–935 kg m⁻³; timber not often utilised.

Climate: Altitudinal range: near sea level to 830 m; Hottest/coldest months: 23–26°C/1–5°C; Frost incidence: low to moderate (may be 20 or more each year at inland sites); Rainfall: 600–1100 mm per year, uniform to summer-autumn max.

Distinctive features: Box-type bark, often tessellated; discolorous leaves at all stages; juvenile leaves crenulate; inflorescences 7-flowered; fruits usually with 4 exserted valves.



Eucalyptus angophoroides 1. Adult leaf venation 2. Buds 3. Seedling 4, 8. Bark 5. Fruits 6. Juvenile leaves 7. Juvenile/intermediate transition leaves 9. Tree, between Candelo and Wyndham, N.S.W. 10. Intermediate leaves 11. Adult leaves

Apple Box But-but

Eucalyptus bridgesiana R.T. Baker

Apple box is a small to medium-sized tree, which attains 12–20 m in height and up to 1 m dbh. The trunk is typically stout and branches at about half tree height. The crown is usually conspicuously green and slightly glossy, and the ultimate branchlets yellowish. Its distinctive seedling and juvenile foliage usually indicate occurrences before adult trees are recognised.

Apple box is widely distributed in south-eastern Australia away from the coast, but not in the drier inland. It occurs principally in New South Wales where it is abundant on the Northern and Southern Tablelands. There is a small overlap in distribution into adjacent far south-eastern Queensland near Wallangarra, Stanthorpe and Dalveen, while to the south it occurs in eastern Victoria north and south of the Great Dividing Range and as far west as Ensay and Glenmaggie and the Warby Range.

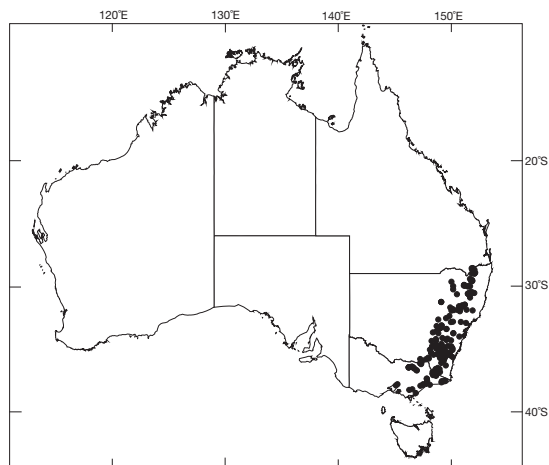
Typically of low to intermediate altitudes, apple box occurs on tablelands, low hills and often along streams. It usually occurs on alluvial soils of a somewhat heavy type over moderately heavy clay derived from fine-grained sedimentary rocks such as slates and cherts.

Although widely distributed, mainly in grassy woodlands, apple box populations seldom form dense stands. Commonly associated trees include yellow box (*E. melliodora*), Blakely's red gum *E. blakelyi*, ribbon gum (*E. viminalis*), candlebark (*E. rubida*), red box (*E. polyanthemos*), red stringybark (*E. macrorhyncha*) and brittle gum (*E. mannifera*).

Related species: Apple box belongs to a small group of four closely related species constituting series *Bridgesianae* (Brooker 2000). Its rough bark may be deceptive and appear to place it with the true boxes, but the versatile anthers distinguish it from the numerous species of section *Adnataria*, which has adnate anthers. Within the *Bridgesianae*, apple box is easily distinguished from the tall, mostly smooth-barked tree species, Dunn's white gum *E. dunni*, of the Northern Tablelands of New South Wales and far south-eastern Queensland, from apple-topped box (*E. angophoroides*) of south coastal areas and adjacent slopes of New South Wales and coastal eastern Victoria, which has green, not pruinose juvenile leaves, and 4-valved fruits (3, rarely 4 in *E. bridgesiana*) and from Moonbi apple box (*E. malacoxylon*) of the southern end of the Northern Tablelands of New South Wales which has larger leaves, stout pedicels, and coarse pruinose buds and fruit with a prominent median flange to the buds.

Publication: *Proc. Linn. Soc. New South Wales* 23, 164 (1898). Types: Gippsland, Vic., A.W. Howitt 101–104, 18; Colombo, New South Wales, W. Baeuerlen; Albury, New South Wales, 21 Jun. 1897, Dr. Andrews; Gerogery, New South Wales, J. Manns; Rylstone, New South Wales, R.T. Baker; Bathurst, New South Wales, W. Woolls.

Names: Botanical name after F. Bridges (1840–1904), Education Officer in New South Wales. Common name of apple is obscure, box refers to the similarity of the bark to the boxes (sect. *Adnataria*).



Bark: Rough and persistent over whole trunk and larger branches, rarely smooth, pruinose, usually tessellated, grey or mottled grey and white.

Leaves: Seedling sessile and opposite for a few pairs, ovate, 5–5.5 × 3–4.5, strongly pruinose. Juvenile becoming shortly petiolate and alternate for many pairs, orbicular to ovate, 2.5–10 × 2–8 cm, crenulate, normally pruinose. Adult alternate, petiolate, falcate or lanceolate, 12–20 × 1.5–2.5 cm, green, glossy, concolorous.

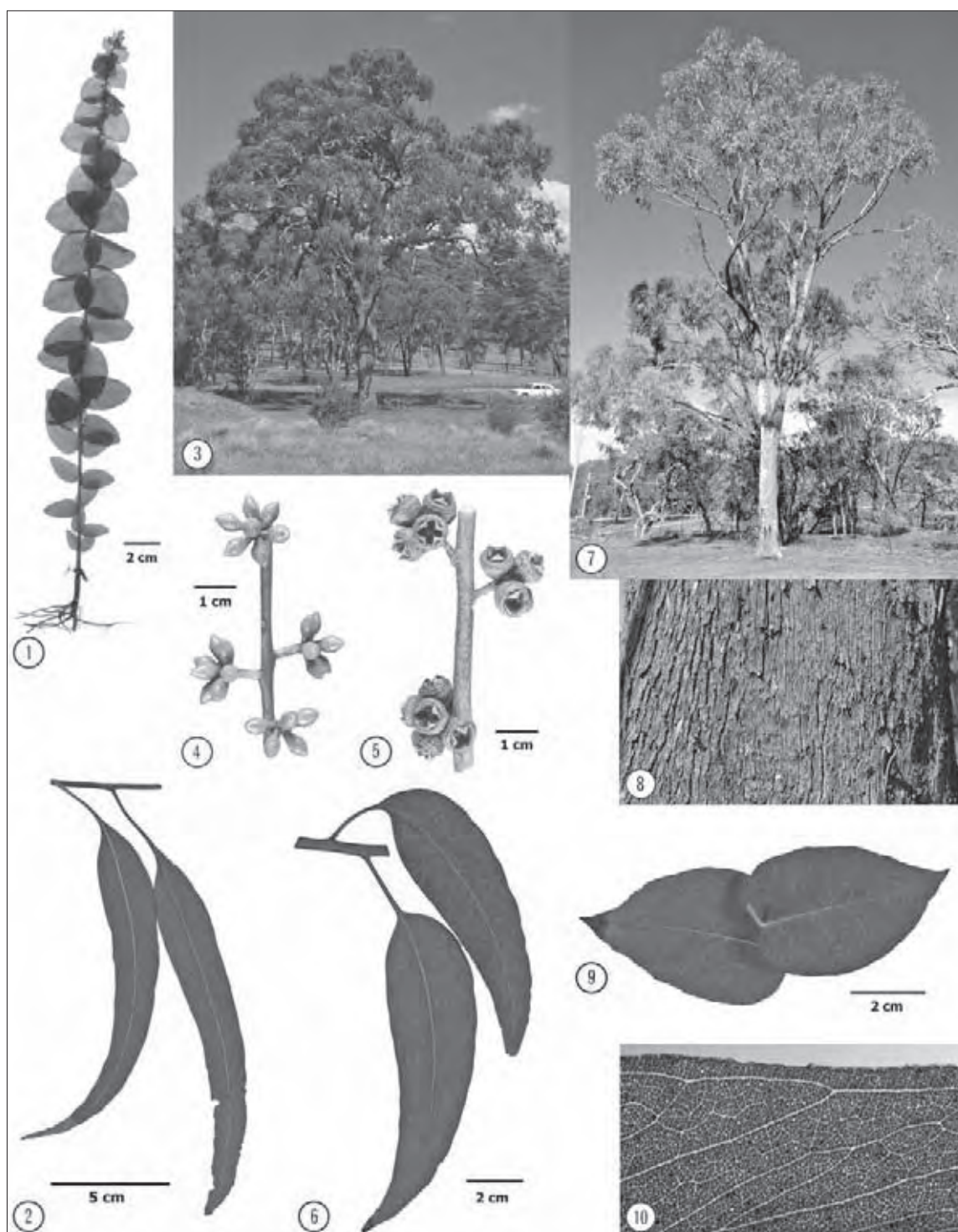
Inflorescences: Simple, axillary, 7-flowered; peduncles slightly flattened, to 1.5 cm long; pedicels to 1.5 cm long; buds ovoid, 0.8 × 0.4 cm; opercula beaked or conical. Flowers Jan–Mar.

Fruits: Shortly pedicellate, hemispherical, up to 0.7 × 0.7 cm; disc raised-annular; valves 3(4) exserted. Seeds ovoid or flattened-ovoid, brownish black, hilum ventral.

Wood: Heartwood is pale-brown with pinkish to orange tints, density range 670–935 kg m⁻³. The wood is soft, extremely prone to collapse and check (crack), brittle and not considered to have commercial value.

Climate: Altitudinal range: near sea level to 830 m; Hottest/coldest months: 20–30°C/4–14°C; Frost incidence: moderate to high (up to 60 or more each year at high elevations); Rainfall: 550–900 mm per year, mainly uniform but summer max. in the north and winter max. in the south of its range.

Distinctive features: Bark rough and usually tessellated over whole trunk at least, with usually a broad crown of green, glossy leaves; seedling and juvenile leaves notably broad, pruinose, petiolate and alternate, crenulate; inflorescences 7-flowered; fruits 3-valved.



Eucalyptus bridgesiana 1. Seedling 2. Adult leaves 3. Tree, near Uralla, N.S.W. 4. Buds 5. Fruits 6. Intermediate leaves 7. Tree, O'Connor, A.C.T. 8. Bark 9. Juvenile leaves 10. Adult leaf venation

Mountain Grey Gum Mountain Gum, Spotted Mountain Grey Gum, Monkey Gum

Eucalyptus cypellocarpa L.A.S. Johnson

Mountain grey gum grows on a wide range of sites and shows a correspondingly large variation in the size of the mature tree and the amount of rough bark retention. On good sites in montane forests it is commonly 35–45 m tall and 1–1.5 m dbh. It may exceptionally attain 65 m in height and exceed 3 m dbh. Under these conditions the trunk is of good form, straight, and half to two-thirds of the total height.

This species is most common in Victoria, mainly south of the Australian Alps in the eastern half of the State, but it also occurs in the Black Range, the Grampians and the Pyrenees of western Victoria, as well as on the central highlands and in the Cape Otway area. In New South Wales the main occurrence is on the coastal side of the Southern Tablelands and adjacent to the Victorian border, occurring as far north as the Central Tablelands.

Mountain grey gum is predominantly a species of mountainous or hilly tableland country but is also found on lowlands. The species grows on a wide range of soils and will tolerate poor sands if there is clay at depth.

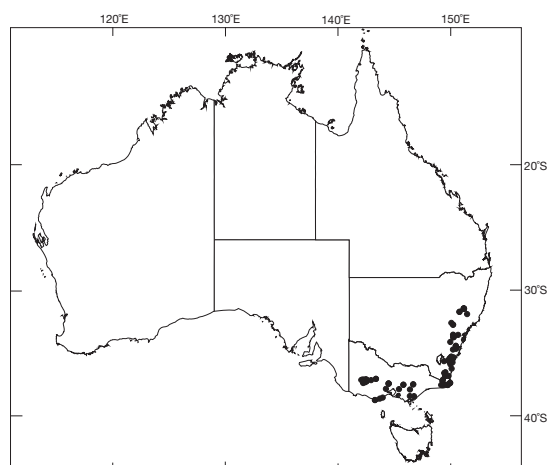
The larger mountain grey gums are found in mountainous areas of tall open eucalypt forests, where they may be associated with many species including messmate (*E. obliqua*), brown barrel (*E. fastigata*), mountain gum (*E. dalrympleana*), manna gum (*E. viminalis*), Maiden's gum (*E. maidenii*) and shining gum (*E. nitens*). On somewhat drier sites there may be various stringybarks, narrow-leaved peppermint (*E. radiata* subsp. *radiata*) and silvertop ash (*E. sieberi*).

Related species: Mountain grey gum belongs in the series *Globulares* subseries *Remanentes* (Brooker 2000), a group notable for the conspicuous large usually pruinose juvenile leaves. Shining gum (*E. nitens*), also a tall tree, sometimes has a stocking of rough bark and smaller, sessile buds and fruits. The very large intermediate leaves, and buds in 7s distinguish mountain grey gum from manna gum (*E. viminalis*) and mountain gum (*E. dalrympleana*), which it may resemble. It also resembles Maiden's gum (*E. maidenii*), which can grow in similar areas, but the latter is recognised by the very large, strongly pruinose juvenile leaves and warty buds. The related *E. volcanica* and *E. retinens* are rough-barked trees of poorer form and much lower stature and have restricted distributions (see Johnson and Hill (1990)). *E. litoralis* (Rule 2005) from near Anglesea in southern Victoria is a rough barked coastal form of *E. cypellocarpa*.

Publication: *Contr. N.S.W. Natl Herb.* 3, 114 (1962). Type: Sawmill to Wynnes Rocks, Mt Wilson, New South Wales, 23 Apr. 1949, L.A.S. Johnson.

Names: Botanical—Greek *cypellon* (cup), *carpos* (fruit), refers to the fruit shape. Common—refers to habitat and presumably bark colour.

Bark: Smooth to ground level, shed in large irregular strips or plates, to leave the stem and branches smooth, yellow, grey and white. Occasionally rough flaky grey bark may be retained on the lower part of the trunk.



Leaves: Seedling—opposite, sessile, amplexicaul, ovate to suborbicular, 4.5–12 × 2.3–7.5 cm, glossy green above, strongly discolorous. Juvenile—opposite to slightly alternate, sessile at first, later ones becoming petiolate, ovate to suborbicular, 8.5–17.5 × 3.5–7.5 cm, glossy green above, strongly discolorous. Intermediate—alternate, petiolate, broad-lanceolate to narrow-lanceolate, 16–35 × 2.5–5 cm (exceptional leaves reputedly to 60 cm long), green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 11–20 × 1–2.5 cm, green, concolorous.

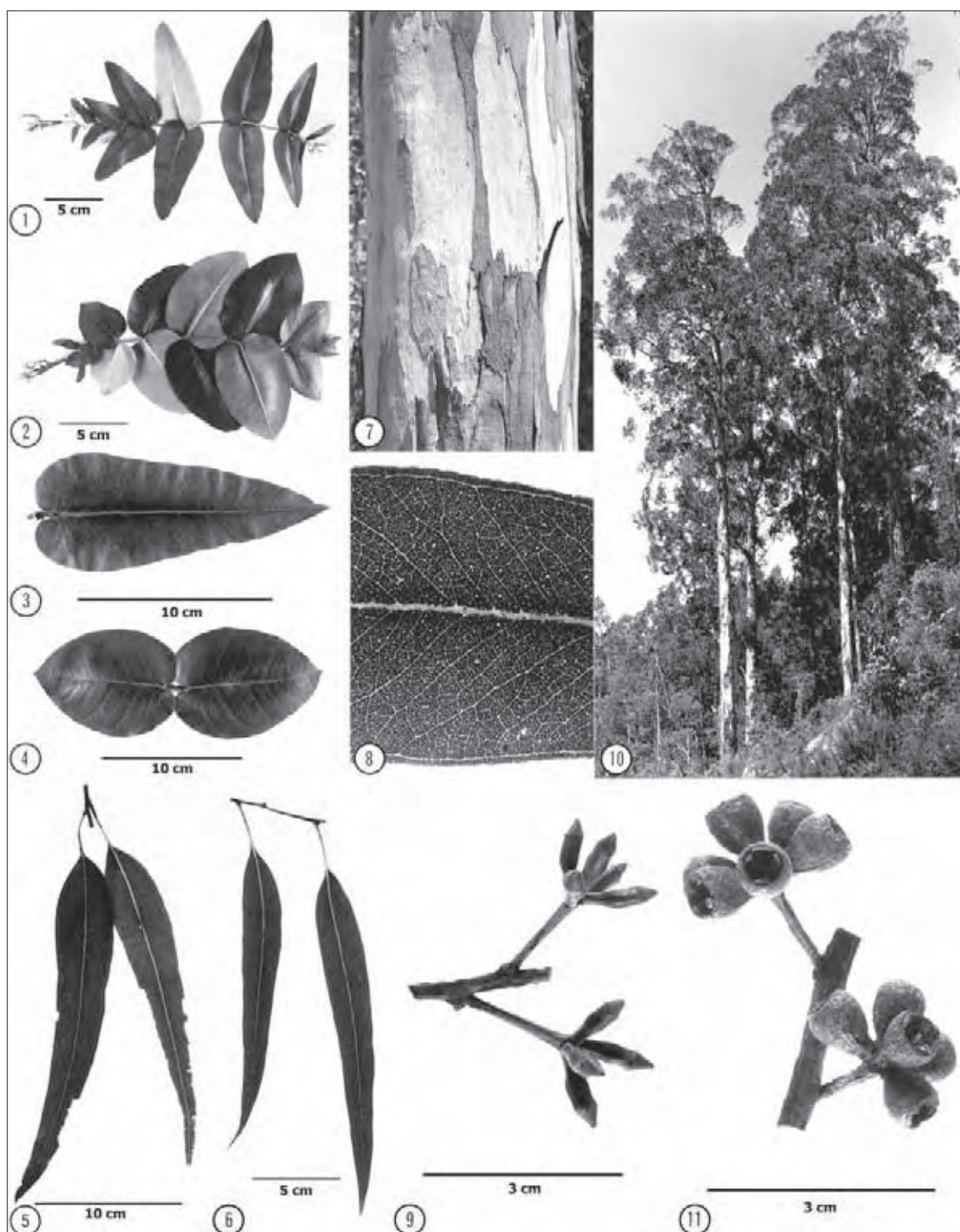
Inflorescences: Simple, axillary, 7(9)-flowered; peduncles distinctly flattened, sometimes very broad, 0.8–2.2 cm long; pedicels absent or 0.1–0.5 cm long and angular, often with ribs continuing along the hypanthia; hypanthia cylindrical; opercula conical; buds 0.8–1.2 × 0.4–0.5 cm. Flowers Dec.–Feb.

Fruits: Sessile or pedicellate, cupular, cylindrical or truncate-ovoid, 0.5–1 × 0.6–0.9 cm, often ribbed; disc moderately broad, descending obliquely or vertically; valves usually 3, to rim level or enclosed, rarely slightly exserted. Seeds flattened-ellipsoidal, grey-brown, hilum ventral.

Wood: Sapwood susceptible to attack by *Lyctus* borers; heartwood pale yellow-brown, with medium texture, straight-grained, hard, heavy, moderately strong, moderately durable; density 655–995 kg m⁻³; used for general construction, structural engineering, bridges, fences, marine craft and for pulp for container board.

Climate: Altitudinal range: near sea level to 1200 m; Hottest/coldest months: 21–31°C/2–7°C; Frost incidence: low to high (up to 100 each year and snow at high elevations); Rainfall: 700–1300 mm per year, mainly uniform to winter max.

Distinctive features: Usually a tall, largely smooth-barked forest tree; juvenile leaves ovate to suborbicular, strongly discolorous; intermediate leaves very large, commonly to 35 cm long; inflorescences 7-flowered on long, flattened peduncles; buds and fruits usually slightly ribbed.



Eucalyptus cypellocarpa 1. Seedling, south of Mongarlowe, N.S.W. 2. Seedling, The Grampians, Vic. 3. Juvenile leaf, south of Mongarlowe, N.S.W. 4. Juvenile leaves, The Grampians, Vic. 5. Intermediate leaves 6. Adult leaves 7. Bark 8. Adult leaf venation 9. Buds 10. Stand, Mt Erica area, north of Yallourn, Vic. 11. Fruits

Shining Gum *Silvertop* (occasionally in N.S.W.)

Eucalyptus nitens (Deane & Maiden) Maiden and *E. denticulata* I.O. Cook & Ladiges

Shining gums are tall to very tall trees commonly 40–70 m in height and occasionally up to 90 m, with dbh of 1–2 m or more. On poorer sites, they may be smaller, but in all cases they typically have good shape and a straight bole, which may be half to two-thirds of the tree height. In high quality forest, the crown is often only of moderate size and is restricted to the top third of the tree.

The more widespread *E. nitens* has a disjunct distribution in the Great Dividing Range and coastal ranges from northern and southern New South Wales to the Victorian high country. In the north of its range, populations are small, disjunct and at altitudes to 1600 m (e.g. Point Lookout, Majors Point, Barren Mountain and Barrington Tops). Populations extending from Tallaganda State Forest in southern New South Wales to stands in the Victorian high country tend to be larger and at altitudes mainly of 800–1400 m. The largest trees are on the undulating tablelands and hills at elevations from 1000–1300 m on either side of the Victorian–New South Wales border and within 120 km of the sea. These stands represent *E. denticulata*, which extends from far south-eastern New South Wales in Bondi State Forest to neighbouring parts of eastern Victoria on the Errinundra Plateau and the adjacent Monkeytop.

These species inhabit high altitude slopes; mountaintops are common habitats. During winter in these areas, falls of snow are common and will remain on the ground for some time. Best development is on deep loamy soils over clay. Substrates include basalt, granite schist, shale and sandstone.

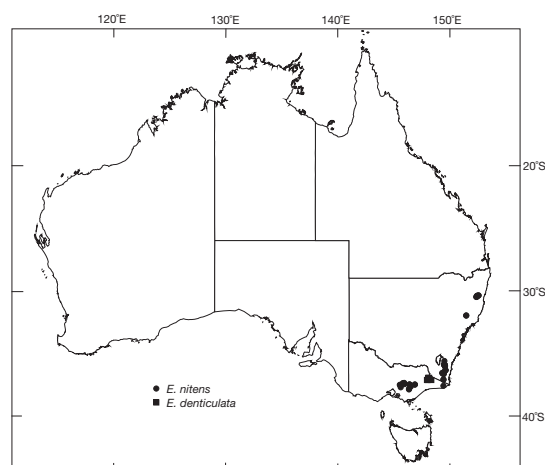
Shining gums grow in tall open forests in pure stands or with other species that include Maiden's gum (*E. maidenii*), mountain grey gum (*E. cypellocarpa*), alpine ash (*E. delegatensis*), mountain ash (*E. regnans*), brown barrel (*E. fastigata*), manna gum (*E. viminalis*), snow gum (*E. pauciflora*) and silver wattle (*Acacia dealbata*).

Related species: Shining gums belong in series *Globulares* which consists of the well-known *E. globulus* and related species (subseries *Euglobulares*) and a second subseries (*Remanentes*), which includes shining gums (Brooker 2000). *E. denticulata* was long recognised as a distinct form but only recognised as a separate, closely related species in 1991. It is similar in habit to *E. nitens* but differs by the extended juvenile leaf phase, the toothed edges of the adult leaves caused by lenticels, and the imperfect formation and shedding of the outer operculum (see below).

Publication: *E. nitens*: Crit. Revis. *Eucalyptus* 2, 272 (1913). Type: Delegate River, New South Wales, May 1889, W. Baeuerlen. *E. denticulata*: Aust. Syst. Bot. 4, 388 (1991). Type: Errinundra Plateau, Gunmark road 0.5 km W of Goonmirk Rocks Road, 3 Mar. 1990, K. Thiele 2262 & S. Prober.

Names: Botanical and common Latin *nitens* (shining, polished, bright); the type description refers to the leaves, buds and fruits and to the bark.

Bark: Smooth throughout, greyish, decorticating in long ribbons, sometimes with a relatively thin basal stocking of



rough bark for a few metres. Saplings and young trees are characteristically green-barked. Horizontal, black, insect marks may be present.

Leaves: Seedling opposite, sessile, amplexicaul, ovate, 4–10 × 2–4 cm, pruinose, bluish, discolorous. Juvenile opposite, sessile, amplexicaul, ovate, 8.5–17 × 4.5–8 cm, pruinose, bluish, discolorous (seedling and juvenile stems are also pruinose and quadrangular), juvenile phase prolonged (*denticulata*) or short (*nitens*). Adult alternate, petiolate, lanceolate to narrow-lanceolate, 13–24 × 1.5–2.5 cm, green, concolorous, edges entire (*nitens*) or toothed (*denticulata*).

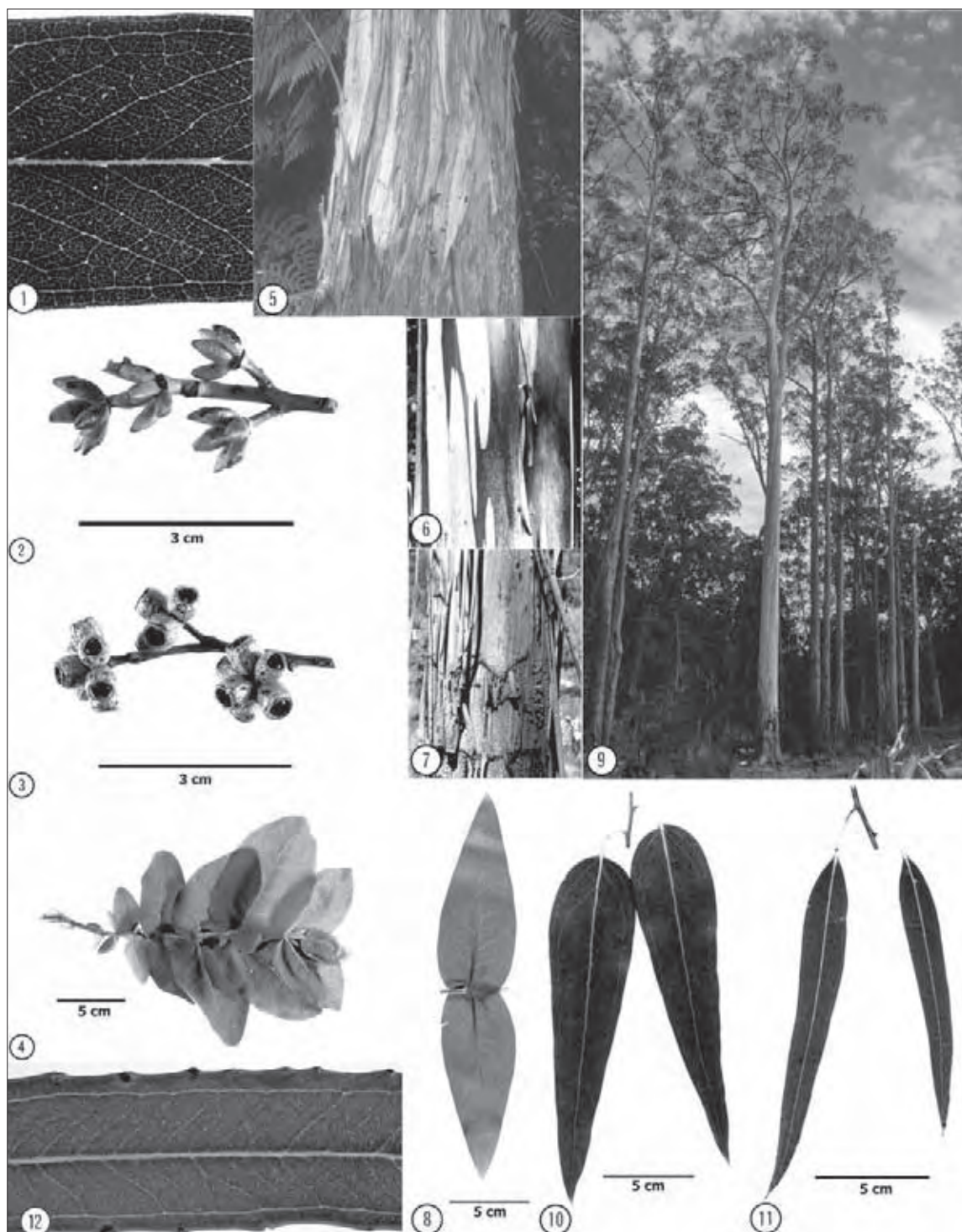
Inflorescences: Simple, axillary, 7-flowered; peduncles angular to somewhat flattened; pedicels usually absent, occasionally very short; buds cylindrical or ovoid, often angular or ribbed, 0.6–0.7 × 0.3 cm; opercula conical, outer opercula shedding early resulting in a median scar (*nitens*), or outer opercula persistent and broken at the tip showing inner opercula (*denticulata*). Flowers Jan.–Mar.

Fruits: Sessile, ovoid, often faintly ribbed, 0.4–0.7 × 0.4–0.6 cm, with a glossy surface; disc narrow, descending; valves 3 or 4, about rim level or slightly exserted. Seeds flattened-ellipsoidal, brown to brown-black, hilum ventral.

Wood: Sapwood susceptible to attack by *Lyctus* borers; heartwood straw-coloured or pale pink, straight-grained, tough but relatively easy to work, not durable; density 530–750 kg m⁻³ (*denticulata* slightly higher and less pink); used for general building construction, flooring, joinery, panelling, furniture and pulp for paper.

Climate: Altitudinal range: 600–1600 m (*nitens*), 880–1000 m (*denticulata*); Hottest/coldest months: 17–24°C/–2–2°C (*nitens*), 20–22°C/–2–1°C (*denticulata*) with 50–150 each year and snow at high elevations; Frost incidence: high (both taxa); Rainfall: 950–2100 mm per year, uniform to summer max. (*nitens*), 950–1570 mm per year, uniform (*denticulata*).

Distinctive features: Tall, non-lignotuberous forest trees of good form; bark smooth throughout, or with a short basal stocking; young trees often have conspicuously green bark; juvenile stems quadrangular; juvenile leaves opposite, sessile, pruinose; fruits ovoid, sessile, with a shiny surface.



Eucalyptus nitens (n), *Eucalyptus denticulata* (d) 1. Adult leaf venation (n) 2. Buds (n) 3. Fruits (n) 4. Seedling 5. Lower bark, mature tree 6, 7. Bark, young trees 8. Juvenile leaves 9. Tree, Tallaganda, N.S.W. (n) 10. Intermediate leaves (n) 11. Adult leaves (n) 12. Adult leaf showing toothed edges (d)

White-topped Box

Eucalyptus quadrangulata Deane & Maiden

White-topped box is generally a tall tree of good form in forest situations, attaining heights of 45 m and dbh up to 1.5 m. Open-grown specimens tend to retain branches to near ground level, while in mountain valleys in the higher rainfall areas the species attains its maximum height with long, clear boles.

White-topped box occurs on the slopes and adjacent edges of the tablelands of central and northern coastal New South Wales. There is also a small, disjunct occurrence in the Mt Mistake, Killarney and Cunninghams Gap region in south-eastern Queensland. White-topped box can be readily seen in the rainforest areas on the inland descent into Kangaroo Valley.

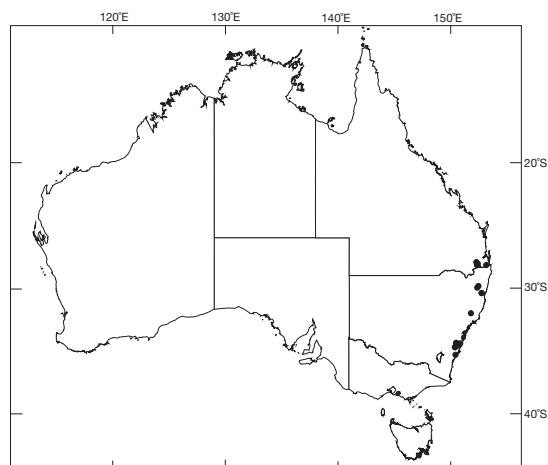
White-topped box prefers moderately heavy soils, generally derived from shale or volcanic parent material. It occurs in open or tall open forests and sometimes as an emergent in closed forests.

Some associated eucalypt species are narrow-leaved white mahogany (*E. acmenoides*), messmate (*E. obliqua*), New England blackbutt (*E. andrewsii* subsp. *campanulata*), silvertop stringybark (*E. laevopinea*), Sydney blue gum (*E. saligna*), grey gum (*E. punctata*) and occasionally tallowwood (*E. microcorys*), southern mahogany (*E. botryoides*), grey box (*E. moluccana*), narrow-leaved peppermint (*E. radiata*) and blackbutt (*E. pilularis*).

Related species: White-topped box belongs in the large group known as the eastern and southern blue gums. The series *Globulares* includes the well-known Tasmanian blue gum (*E. globulus*) (subseries *Euglobulares*), and a second subseries (*Remanentes*), which includes shining gums (*E. nitens* and *E. denticulata*) (Brooker 2000). White-topped box is rough-barked, a character it shares with the poorer-formed Hillgrove box (*E. retinens*) and long-leaved box (*E. goniocalyx*). Nevertheless, white-topped box has closest affinities with the shining gum (*E. denticulata*) as it shares the conspicuous, typical prolonged southern blue gum juvenile leaf character (although not pruinose), the rare adult leaf form with the toothed edges caused by lenticels, and similar buds and fruits, although the entire outer operculum shows affinity as well with *E. nitens*. It is easy to check the leaf character from fallen leaves. In the field the species may be confused with the peppermint-barked *E. radiata*, which has smaller, entire, strongly smelling leaves (on crushing) and buds and fruits in more than 7s. The box-type bark of white-topped box may cause it to be confused with the unrelated true boxes (e.g. *E. ruderi*, *E. largeana*), which look remarkably alike in the field and can be found in the same general areas. These two species have entire leaves, terminal inflorescences, pedicellate buds and fruits, and adnate anthers.

Publication: *Proc. Linn. Soc. N.S.W.* 24, 451 (1899). Type: Hill Top, New South Wales, Sep. 1899, J.H. Maiden and J.L. Boorman.

Names: Botanical Latin *quadrus* (fourfold), *angulatus* (angled), of the juvenile stems. Common name refers to the bark which is very similar to that of true boxes, while white-topped is rather obscure.



Bark: Rough and persistent to the small branches; grey, Pnec, subPnec, often irregularly tessellated, very similar to the true box species.

Leaves: Seedling: Opposite, sessile, amplexicaul, ovate to broad-lanceolate, 3.5–11 × 1.5–4 cm, green, discolorous. Juvenile: Opposite, sessile, ovate to broad-lanceolate, 11–14 × 3–4 cm, green, discolorous. Seedling and juvenile stems are conspicuously quadrangular with flanged edges. Intermediate: Alternate, petiolate, broad-lanceolate to lanceolate, 15–20 × 2–4 cm, green, concolorous. Adult: Alternate, petiolate, lanceolate to narrow-lanceolate, 10.5–20 × 0.9–2 cm, green, concolorous, leaf edges toothed due to lenticels.

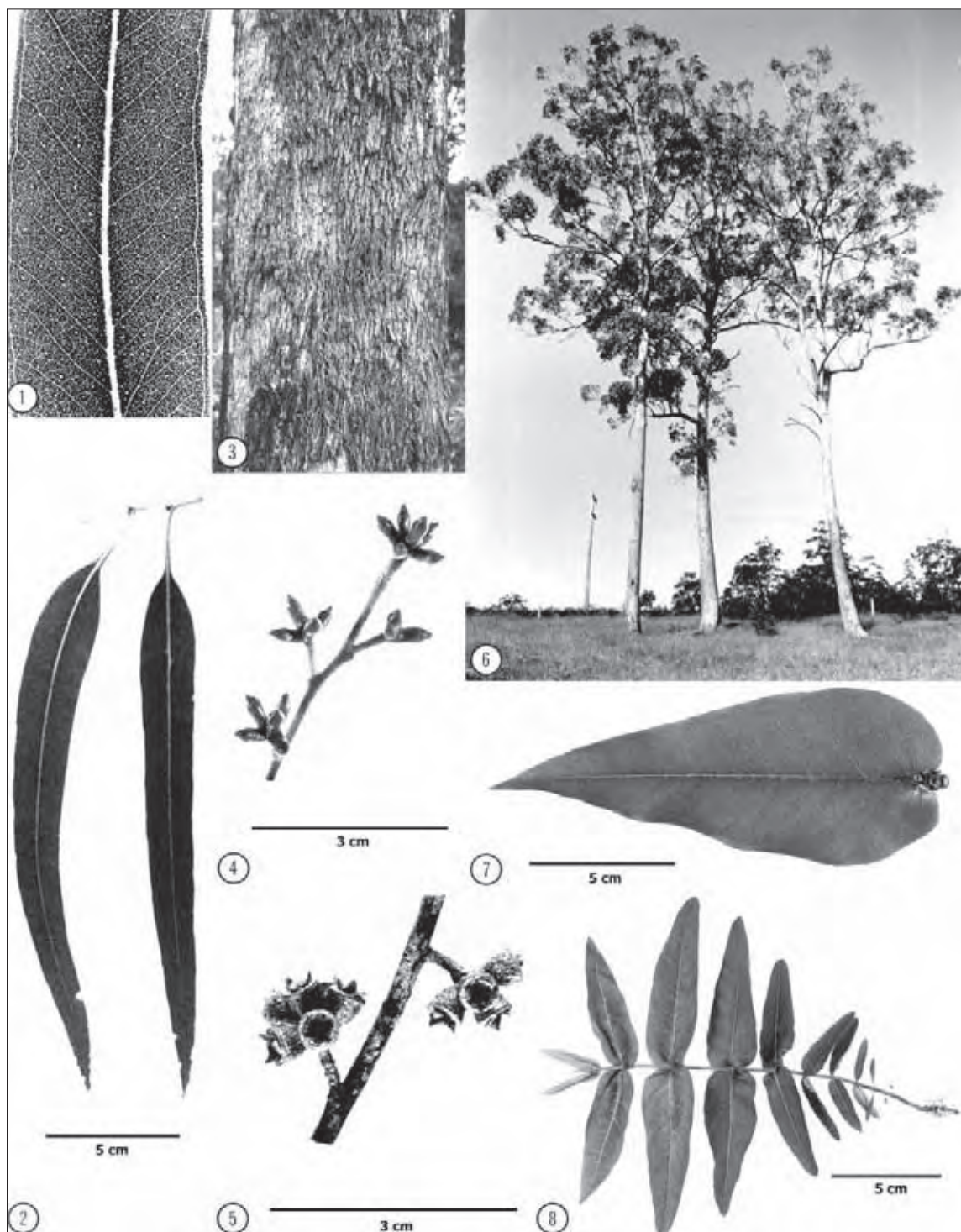
Inflorescences: Simple, axillary, 7-flowered; peduncles angular to flattened, 0.3–1.1 cm long; pedicels usually absent, sometimes present but short and stout, particularly for the central bud; buds fusiform, 0.5–0.8 × 0.3–0.45 cm; opercula conical. Flowers Feb.–Mar.

Fruits: Sessile or shortly pedicellate, obconical or cupular, 0.4–0.7 × 0.4–0.6 cm; disc of moderate width, more or less level; valves 3 or 4, exserted. Seeds flattened-ellipsoidal, grey-brown, hilum ventral.

Wood: Sapwood seldom attacked by *Lyctus* borers; heartwood pale yellow-brown often indistinct from sapwood, moderately Pnec-textured, very hard, durable to very durable; density about 1020 kg m⁻³; used for heavy engineering construction, poles and railway sleepers and useful as flooring. Similar in appearance to New England blackbutt (*E. andrewsii*).

Climate: Altitudinal range: 100–900 m; Hottest/coldest months: 26–28°C/0–3°C; Frost incidence: moderate to high (up to 50 each year at high elevations); Rainfall: 900–1700 mm per year, uniform to summer max.

Distinctive features: An erect tree with box-type bark, quadrangular juvenile stems, sessile juvenile leaves and the toothed adult leaves make it relatively easy to identify.



Eucalyptus quadrangulata 1. Adult leaf venation 2. Adult leaves 3. Bark 4. Buds 5. Fruits 6. Trees, west of Camden, N.S.W. 7. Juvenile leaf 8. Seedling

Eurabbie Southern Blue Gum, Blue Gum, Victorian Blue Gum

Eucalyptus bicostata Maiden, Blakely and J.H. Simmonds

Tallest trees of eurabbie are 30–45 m in height, with a 1–1.3 m dbh. They have good form with a straight trunk up to two-thirds of the total height. In drier forests it is more often a rather low-branched, bushy tree of 15–25 m.

Eurabbie has its principal occurrence in Victoria, but a number of isolated disjunct stands occur in various parts of New South Wales as far north as Carrai State Forest, west of Kempsey and in the Nundle and Walcha districts of the Northern Tablelands. The best development and largest area of commercial forest is on the northern slopes of the Australian Alps in north-eastern Victoria. Eurabbie intergrades with close relatives where populations overlap. In the Orbost region, it intergrades with *E. pseudoglobulus* while at Jeeralang in the Strzelecki Ranges it intergrades with *E. globulus*. There is a small isolated population near Mt Bryan, north of Burra in South Australia.

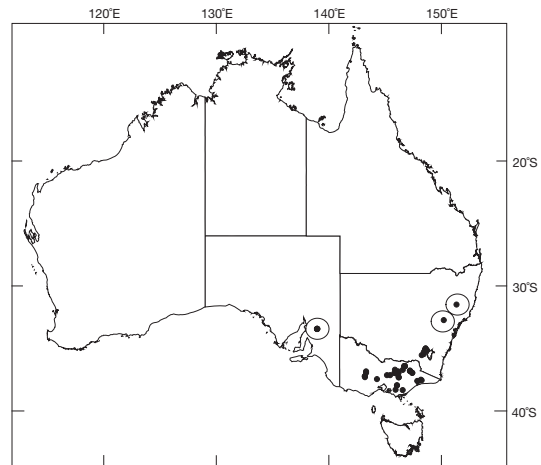
Best development for this species is on plateaux in hilly or mountainous country, while it also occurs on escarpments, in valleys and on the edges of plains. It prefers a rather heavy soil or good quality loam (often basaltic) with adequate moisture.

Eurabbie occurs in open or tall open forests. Associated eucalypt species include narrow-leaved peppermints (*E. radiata* both subspp.), candlebark (*E. rubida*), broad-leaved peppermint (*E. dives*), brittle gum (*E. mannifera*), ribbon gum (*E. viminalis*), messmate (*E. obliqua*), mountain grey gum (*E. cypellocarpa*), apple box (*E. bridgesiana*) and snow gum (*E. pauciflora*).

Related species: Eurabbie belongs in the large group known as the eastern and southern blue gums. It belongs in the series *Globulares*, subseries *Euglobulares*, which includes the well-known Tasmanian blue gum (*E. globulus*) (Brooker 2000). Kirkpatrick (1974) recognised *E. bicostata*, *E. globulus*, *E. maidenii* and *E. pseudoglobulus* as subspecific forms of *E. globulus*. For convenience we refer to them by their species names, by which they were previously formally recognised. Within the subseries, southern blue gum shares the 3-flowered character with *E. pseudoglobulus*, which differs by the smaller, stoutly pedicellate buds and fruits and mostly grows in warmer, lower altitude regions. Eurabbie is easily distinguished from the single-flowered *E. globulus* and the 7-flowered *E. maidenii*. The four species of the subseries are closely related. It may be difficult to establish the precise identity of some individuals and populations, particularly in Victoria, through incomplete divergence resulting in intergrades. This problem is not encountered in northern occurrences of eurabbie.

Publication: *E. bicostata*: in J. Simmonds, *Trees Shelter & Timber New Zealand, Eucalypt* 133, t. 48 (1929). Type: Mundaroo State Forest, Tumbarumba, New South Wales, Jul. 1921, W.A.W. de Beuzeville.

Names: Botanical Latin *bi-* (two), *costatus* (ribbed), in reference to the two ridges commonly found on the buds and fruits. Common refers to the southern blue gum group of eucalypts.



Bark: Largely smooth and white or greyish; some older unshed or partially shed brownish bark is often retained near the base.

Leaves: Seedling—opposite, sessile, amplexicaul, ovate, 6–11 × 3–5 cm, greyish green, pruinose, strongly discolorous; stems square in section and strongly flanged. Juvenile—opposite, sessile, amplexicaul, ovate, 11–15 × 6–8 cm; colour and stems as for seedling stage. Adult—alternate, petiolate, falcate or lanceolate to narrow-lanceolate, 14–30 × 2–3 cm, Prm, green, concolorous.

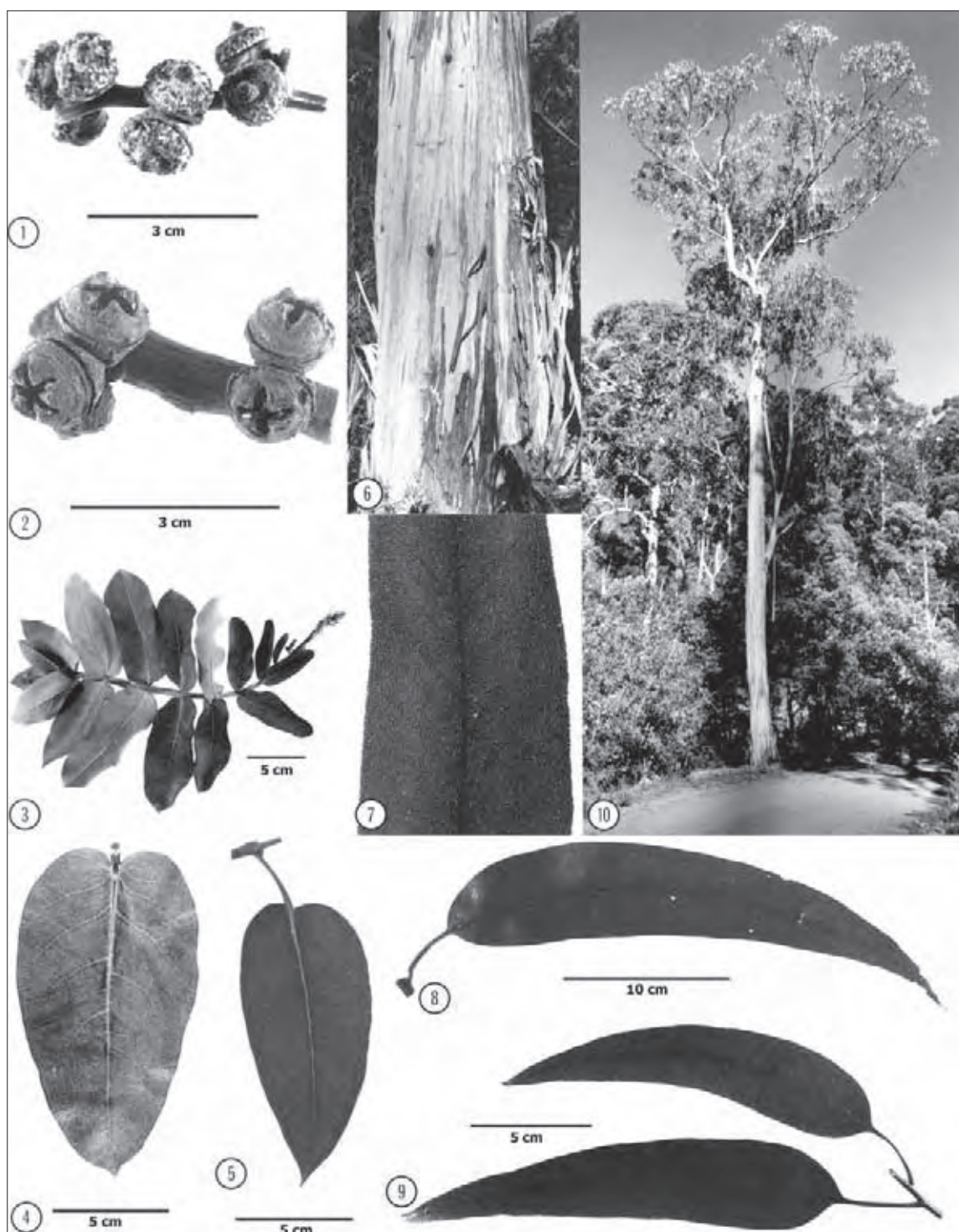
Inflorescences: Simple, axillary, 3-flowered; peduncles stout, 0.1–0.3 cm long; pedicels usually absent, though sometimes the central bud is shortly pedicellate; buds 1.4–1.7 × 1.1–1.3 cm, warty, pruinose, with hypanthia distorted and flattened by compression (particularly the central bud); opercula more or less flattened, with a distinct central mucro or knob and a very distinct indentation at the join with the hypanthia. Flowers Sept.–Jan.

Fruits: Sessile, more or less globular (including the disc), 0.8–1.7 × 1–2 cm; hypanthia warty, pruinose and 2-ribbed; disc very broad, ascending and forming prominent raised lobes partly covering the valves; valves 3 or 4, mostly below the raised lobes of the disc. Seeds flattened-ellipsoidal, black-brown, hilum ventral.

Wood: Sapwood susceptible to attack by *Lyctus* borers; heartwood light yellowish brown with orange tints rarely pinkish, grain straight to usually interlocked, intermediate to moderately fine-textured, with distinct growth rings, strong, moderately durable; density 660–900 kg m⁻³, used for general construction purposes.

Climate: Altitudinal range: 30–1300 m; Hottest/coldest months: 20–28°C/–2–6°C; Frost incidence: low to high (25–70 each year at high elevations); Rainfall: 600–1600 mm per year, winter to summer max.

Distinctive features: A tall tree with mostly smooth bark; young stems square in section; juvenile leaf phase prolonged and conspicuous in the field, juvenile stems and leaves pruinose; inflorescences axillary, 3-flowered; peduncles very short and stout; buds and fruits sessile, warty, pruinose, 2-ribbed; intermediate leaves up to 40 cm long.



Eucalyptus bicostata 1. Buds 2. Fruits 3. Seedling 4. Juvenile leaf 5. Juvenile/intermediate transition leaf 6. Bark 7. Adult leaf venation 8. Intermediate leaf 9. Adult leaves 10. Tree, between Corryong and Omeo, Vic.

Tasmanian Blue Gum Southern Blue Gum, Blue Gum

Eucalyptus globulus Labill.

Tasmanian blue gum varies from a medium-sized woodland tree 15–20 m in height with branches retained to less than half the total height, to an impressive forest tree of excellent form, to 70 m in height and 2 m dbh, with a long, straight bole to around two-thirds of the total height. Occasionally on very harsh, exposed sites such as Flinders and King Islands it may be reduced to a mallee-like shrub.

Tasmanian blue gum occurs mainly along the east coast of Tasmania south from the St Helens area to South East Cape, including Bruny Island, mostly within 20 km of the sea, but in some areas up to about 60–70 km inland. The best stands occur south of its distribution in Tasmania and it is less common in the north. Small, often fragmented populations occur on Flinders, King and Cape Barren Islands in Bass Strait. There are several isolated stands along the west coast of Tasmania.

This species grows on gently undulating country near the sea but best development occurs in moist valleys in hilly areas on good quality loams. It occurs on dolerite and on shallow humus soils over mudstone. In coastal areas it is often found on rather poor sands.

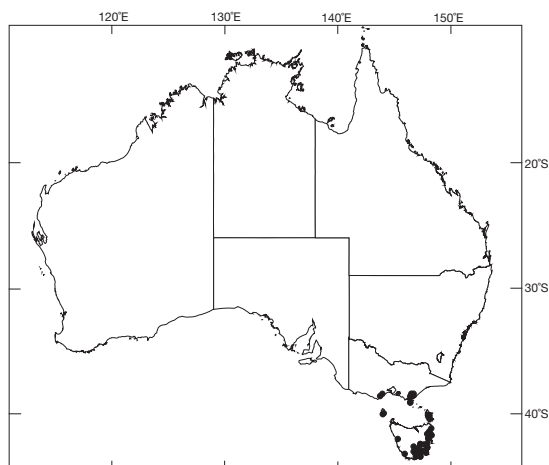
Tasmanian blue gum occurs in woodlands and open or tall open forests. Associated eucalypt species include manna gum (*E. viminalis*), swamp gum (*E. ovata*), mess-mate (*E. obliqua*), black peppermint (*E. amygdalina*), Smithton peppermint (*E. nitida*), white peppermint (*E. pulchella*), alpine ash (*E. delegatensis*) and mountain ash (*E. regnans*).

Related species: Tasmanian blue gum belongs in the large group known as the eastern and southern blue gums. It belongs in series *Globulares*, subseries *Euglobulares* with *E. bicostata*, *E. maidenii* and *E. pseudoglobulus* (Brooker 2000). Kirkpatrick (1974) recognised the taxa of subseries *Euglobulares* as subspecific forms of *E. globulus*. For convenience we refer to them by their species names, by which they were previously formally recognised. Within the subseries, Tasmanian blue gum is easily distinguished by the single-flowered inflorescences, contrasting with the 3-flowered *E. bicostata* and *E. pseudoglobulus* and the 7-flowered *E. maidenii*. The four species of the subseries are closely related. It may be difficult to establish the precise identity of some individuals and populations where distributions overlap. Tasmanian blue gum is distinct from the other tall smooth-barked species in Tasmania, viz, *E. johnstonii* and *E. subcrenulata* which have less conspicuous, glossy green juvenile leaves and buds and fruits in 3s.

Publication: *Voy. Rech. Perouse* 1, 153 (1799). Type: Probably Recherche Bay, south-east Tasmania, Dec. 1792, J. Labillardiere.

Names: Botanical Latin *globulus* (a little button) refers to the operculum shape. Common refers to locality and to the blue gum group (distinctive bluish juvenile foliage).

Bark: Usually with a stocking of rough, greyish or brownish bark at the base, decorticating above in long strips leaving a smooth yellowish or greyish surface.



Leaves: Seedling Opposite, sessile, amplexicaul, ovate, 6–12 × 2.5–7 cm, bluish green, pruinose, strongly discolorous. Juvenile Opposite, sessile, amplexicaul, elliptic-ovate, 11–15 × 6–10.5 cm, bluish green, pruinose, strongly discolorous. Seedling and juvenile stems are square in section, flanged and pruinose. Intermediate Alternate, petiolate, broad-lanceolate to narrow-lanceolate, 20–35 (–50) × 3–8 cm, green, concolorous. Adult Alternate, petiolate, falcate or lanceolate to narrow-lanceolate, 12–30 × 1.7–3 cm, glabrous, glossy, green, concolorous.

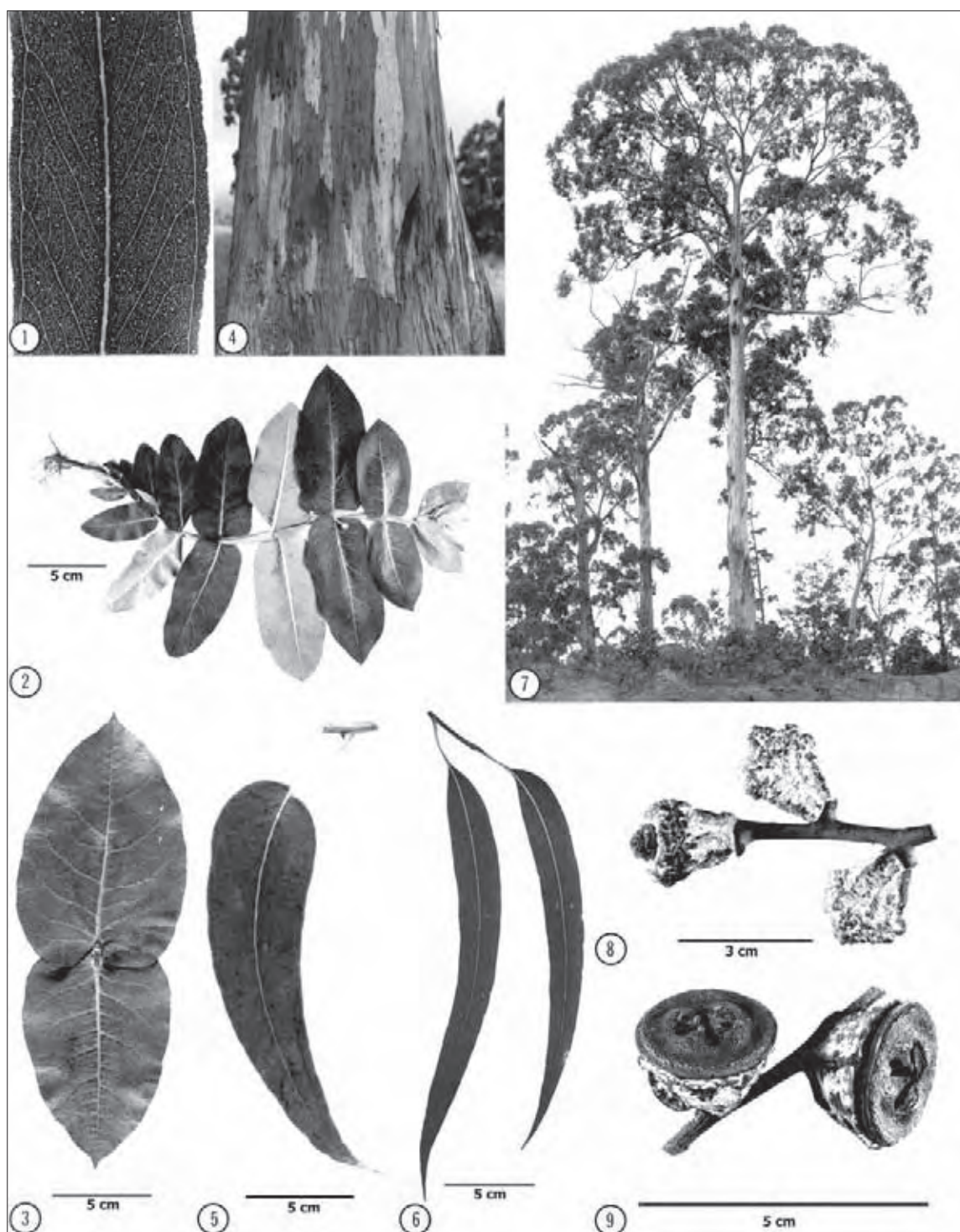
Inflorescences: Simple, axillary, usually 1-flowered, occasionally 3; peduncle sometimes absent or very short and stout, up to 0.4 cm long; pedicels usually absent, occasionally very short; buds more or less turbinate, 1.5–2.3 × 1.4–1.8 cm, with 4 (or occasionally more) very distinct ribs, extremely pruinose; opercula flattened with a very distinct central knob, very warty. Flowers Sept.–Dec.

Fruits: Sessile, subglobose to more or less hemispherical, 1–2 × 1.4–2.4 cm, with 4 (or occasionally more) very distinct ribs, pruinose on hypanthia; disc broad, more or less level or ascending, with slight lobes; valves 4 or 5, more or less horizontal and at rim level or slightly exserted, partly covered by the disc lobes. Seeds flattened-ellipsoidal, black-brown, hilum ventral.

Wood: Heartwood light yellowish brown, open-textured, grain commonly interlocked, distinct growth rings, strong, moderately durable; density 670–1010 kg m⁻³ from old growth natural forest, but around 500–740 kg m⁻³ from plantation trees; used for light and heavy construction, poles, piles, railway sleepers and woodchips for pulp and paper production. This species has become an important source of fast-growing pulpwood from plantations established in temperate Australia and overseas (e.g. Portugal, Chile).

Climate: Altitudinal range: near sea level to 540 m; Hottest/coldest months: 18–24°C/0–7°C; Frost incidence: moderate to high (up to 50 each year at high elevations); Rainfall: 600–1400 (–1800) mm per year, uniform to winter max.

Distinctive features: Varies from a mallee-like shrub to a very tall forest tree; largely smooth-barked; inflorescences usually with solitary buds; buds, fruits, juvenile stems and leaves pruinose; juvenile leaf phase prolonged and conspicuous in the field, fruits up to 2.4 cm diameter, 4-ribbed.



Eucalyptus globulus 1. Adult leaf venation 2. Seedling 3. Juvenile leaves 4. Bark 5. Intermediate leaf 6. Adult leaves 7. Tree, between Kettering and Snug, Tas. 8. Buds 9. Fruits

Maiden's Gum

Eucalyptus maidenii F. Muell.

Maiden's gum is a tall to very tall forest tree usually 30–45 m in height but at its best attaining 75 m with a dbh up to 2.5 m. It is usually of good form with clear, straight trunks often to two-thirds of the total height.

Maiden's gum occurs in the South Coast region of New South Wales mainly on the slopes of the coastal escarpment south from the Moss Vale area to eastern Victoria in the subcoastal ranges in the Genoa and Cann Rivers region.

Best development of this species is in moist, sheltered mountain valleys but, provided soils and rainfall are adequate, it also thrives on ridges and mountain slopes. Common soil types are moderately fertile loams and sandy loams often derived from granitic parent material. It also occurs commonly on shale sites.

Maiden's gum is a species of open or tall open forests, commonly associated with mountain grey gum (*E. cypellocarpa*), gully gum (*E. smithii*), messmate (*E. obliqua*), brown barrel (*E. fastigata*), silvertop ash (*E. sieberi*), yellow stringybark (*E. muelleriana*), blue-leaved stringybark (*E. agglomerata*), white stringybark (*E. globoides*) and river peppermint (*E. elata*).

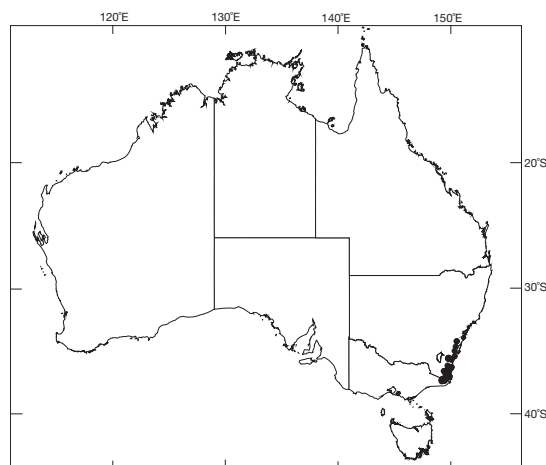
Related species: Maiden's gum belongs in the large group known as the eastern and southern blue gums. It belongs in the series *Globulares*, subseries *Euglobulares*, which includes the well-known Tasmanian blue gum (*E. globulus*) (Brooker 2000). Kirkpatrick (1974) discussed at length the variation patterns in this group and recognised *E. bicostata*, *E. globulus*, *E. maidenii* and *E. pseudoglobulus* as subspecific forms of *E. globulus*. For convenience here we refer to them by their species names, by which they were previously formally recognised. Maiden's gum is distinguished by having buds in 7s rather than singly as in *E. globulus* or in 3s as in *E. bicostata* and *E. pseudoglobulus*. Maiden's gum differs from other 7-flowered blue gums by the warty buds with flattened opercula wider than the hypanthium. The four species of the subseries are closely related and it may be difficult to establish the precise identity of some individuals and populations where distributions overlap.

Publication: *E. maidenii*: *Proc. Linn. Soc. N.S.W.* 4, 1020 (1890). Type: Between Candelo and Colombo, New South Wales, Jun. 1887, W. Baeuerlen.

Names: Botanical and common both honour J.H. Maiden (1859–1925), Government Botanist of New South Wales and Director of the Botanic Gardens, Sydney, and one of the most eminent researchers of the genus *Eucalyptus*.

Bark: Smooth, whitish or cream, decorticate in strips to ground level, or sometimes with a short stocking of undecorticated rough bark.

Leaves: Seedling: Opposite, sessile, amplexicaul, ovate, 7–10 × 3.5–5 cm, greyish green, pruinose, strongly discolorous. Juvenile: Opposite, sessile, amplexicaul, ovate, 9–15 × 4.5–9 cm, greyish green, pruinose, strongly discolorous. Seedling, juvenile stems square in section and flanged. Intermediate: Alternate, petiolate, broad-lanceolate to lanceolate, 19–30 × 2.5–5 cm, green, concolorous. Adult:



alternate, petiolate, often falcate but also lanceolate to narrow-lanceolate, 12–28 × 1.2–2.5 cm, glabrous, glossy, green, concolorous.

Inflorescences: Simple, axillary, usually 7-flowered (occasionally 11- and very rarely 3-flowered); peduncles flattened, 0.8–2.5 cm long; pedicels absent or 0.1–0.8 cm long and angular, the angles continuing as ribs along the hypanthia; buds more or less clavate, 0.8–1 × 0.5–0.7 cm; opercula flattened with a prominent pointed tip, usually warty, distinctly broader than the hypanthia. Branchlets and inflorescences are commonly green but sometimes distinctly pruinose. Flowers Mar.–Sept.

Fruits: Sessile to distinctly pedicellate, more or less obconical, 0.5–1.1 × 0.6–1 cm, occasionally pruinose, faintly to distinctly ribbed; disc relatively broad, more or less level to ascending; valves 3 or 4, short, broad, slightly to distinctly exserted. Seeds flattened-ellipsoidal, black-brown, hilum ventral.

Wood: Sapwood susceptible to *Lyctus* borer attack; heartwood light brown with pinkish to orange tints, with moderately coarse but uniform texture, grain sometimes interlocked, hard, moderately strong and moderately durable; density 805–1070 kg m⁻³, used for general construction purposes.

Climate: Altitudinal range: 220–650 m; Hottest/coldest months: 23–25°C/0–4°C; Frost incidence: moderate (about 20–80 each year at high elevations); Rainfall: 800–1200 mm per year, uniform.

Distinctive features: A tall, smooth-barked forest tree of good form with mostly smooth bark; young stems square in section; juvenile leaf phase prolonged and conspicuous in the field; juvenile leaves sessile, amplexicaul, pruinose and strongly discolorous; simple, axillary, mostly 7-flowered inflorescences; opercula warty; distinctly wider than hypanthia.



Eucalyptus maidenii 1. Adult leaves 2. Seedling 3. Buds 4. Intermediate leaves 5. Bark 6. Adult leaf venation 7. Juvenile leaf 8. Tree, west of Nelligen, N.S.W. 9. Fruits

Gippsland Blue Gum

Eucalyptus pseudoglobulus Maiden

Gippsland blue gum is a medium-sized to tall tree 15–45 m tall with a dbh up to 1.5 m. It is generally of good form with clear, straight trunks to more than half the tree height in forest situations, while more open-grown specimens retain more of the lower branches.

Gippsland blue gum occurs on the coast and nearby low ranges of eastern Victoria, particularly from Bairnsdale to Mallacoota, and may just extend into the south-eastern corner of New South Wales (Nadgee Nature Reserve). Disjunct populations in the Maffra area, Lerderderg Gorge near Bacchus Marsh and on the northern end of Flinders Island in Bass Strait are also considered to be *E. pseudoglobulus*. It appears to intergrade with *E. bicostata* in areas north of Orbost and with *E. globulus* in southern Gippsland and the Otway Ranges.

This species prefers the lower slopes of sheltered valleys, but also grows on the lower and mid-slopes of undulating and moderately hilly country. The soils are usually alluvials with a clay subsoil.

Gippsland blue gum occurs in open or tall open forests. Commonly associated tree species include mountain grey gum (*E. cypellocarpa*), white stringybark (*E. globoidea*), coast grey box (*E. bosistoana*), blue box (*E. baueriana*), river peppermint (*E. elata*), silvertop ash (*E. sieberi*) and black oak (*Allocasuarina littoralis*).

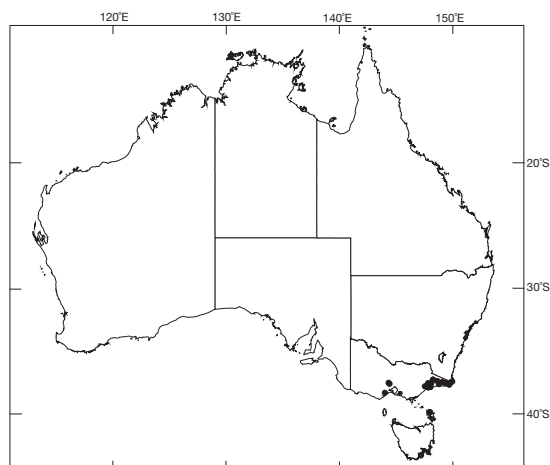
Related species: Gippsland blue gum belongs in the large group known as the eastern and southern blue gums. It belongs in the series *Globulares*, subseries *Euglobulares*, which includes the well-known Tasmanian blue gum (*E. globulus*) (Brooker 2000). Kirkpatrick (1974) recognised *E. bicostata*, *E. globulus*, *E. maidenii* and *E. pseudoglobulus* as subspecific forms of *E. globulus*. For convenience we refer to them by their species names, by which they were previously formally recognised. Within the subseries, Gippsland blue gum shares the 3-flowered character with *E. bicostata*, which differs by the larger, sessile buds and fruits and mostly grows in colder, higher altitude regions. Gippsland blue gum is easily distinguished from the single-flowered *E. globulus* and the 7-flowered *E. maidenii*. The four species of the subseries are closely related and form intergrade populations where distributions overlap.

Publication: *E. pseudoglobulus*: Crit. Revis. *Eucalyptus* 8, 28 (1929). Lectotype *vide* Kirkpatrick (1974) Metung, Victoria, Aug. 1909, J.L. King.

Names: Botanical Greek *pseudo-* (false, resembling but not equal), refers to the similarity of this species to *E. globulus*. Common refers to the area in which the species is most common and to the southern blue gum group of eucalypts.

Bark: Decorticating in strips to leave a smooth, blotched, white, yellowish or greyish surface; a short basal stocking of undecorticated greyish or brown rough bark may be retained.

Leaves: Seedling Opposite, sessile, amplexicaul, ovate, 7–10 × 2.5–5 cm, greyish green, pruinose; strongly discolorous. Juvenile Opposite, sessile, amplexicaul, ovate, 10–23 × 5–11 cm, greyish green, pruinose, strongly discolorous. Seedling and juvenile stems are square in section



and flanged. Intermediate Alternately, petiolate, broad-lanceolate to lanceolate, 14–35 × 3–8 cm, green, concolorous. Adult Alternately, petiolate, falcate or lanceolate to narrow-lanceolate, 13–35 × 1.5–3 cm, glaucous, glossy, green, concolorous.

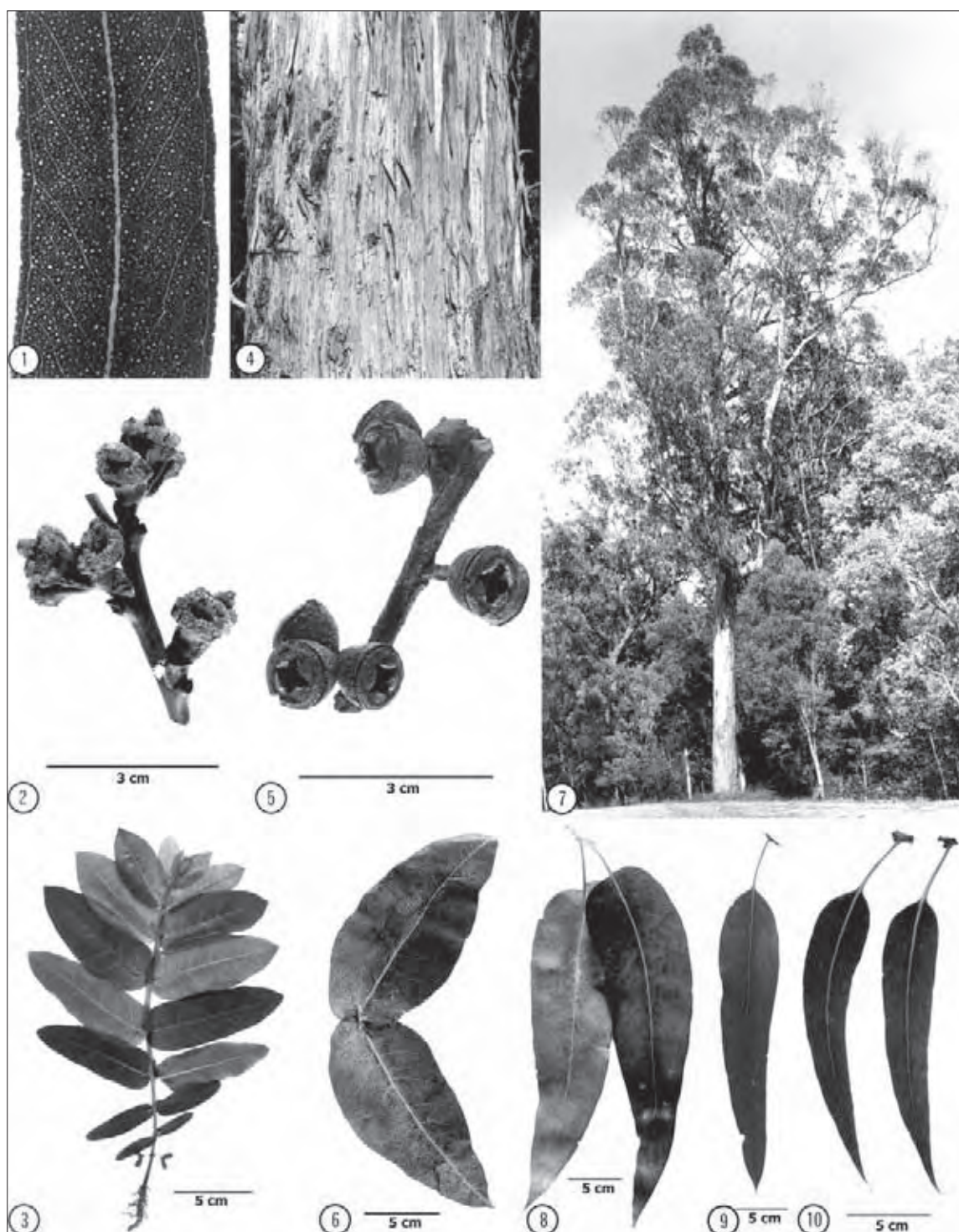
Inflorescences: Simple, axillary, mostly 3-flowered; peduncles broad, flattened, 0.6–1 cm long; pedicels up to 0.5 cm long, stout and angular (quite often the 2 outer buds are sessile while the central bud has a distinct pedicel); buds 0.8–0.9 × 0.6–0.7 cm, often strongly ribbed, sometimes pruinose; opercula flattened, with a distinct central knob, warty, distinctly wider than hypanthia. Flowers Jan.–Feb.

Fruits: Sessile or sometimes shortly pedicellate, more or less globular including the disc, though often with a flared rim, 0.7–1.1 × 0.9–1.6 cm, sometimes pruinose; disc broad, ascending, forming prominent lobes; valves 3 or 4, partly covered by the lobes of the disc. Seeds flattened-ellipsoidal, black-brown, hilum ventral.

Wood: The physical properties are probably similar to the two close relatives *E. bicostata* and *E. maidenii*, tends to be without pinkish tints.

Climate: Altitudinal range: near sea level to 740 m; Hottest/coldest months: 24–27°C/2–4°C; Frost incidence: low to moderate (1–15 each year at non-coastal sites); Rainfall: 700–1100 mm per year, uniform to a slight winter-spring max.

Distinctive features: A medium-sized to tall, mostly smooth-barked tree; young stems square in section; juvenile leaf phase prolonged and conspicuous in the field, juvenile leaves pruinose adult leaves very long and narrow (up to 35 × 2 cm); inflorescences mostly 3-flowered; buds and fruits sessile or shortly pedicellate (usually central bud); opercula warty, distinctly wider than hypanthia.



Eucalyptus pseudoglobulus 1. Adult leaf venation 2. Buds 3. Seedling 4. Bark 5. Fruits 6. Juvenile leaves 7. Tree, between Lakes Entrance and Orbost, Vic. 8. Juvenile/intermediate transition leaves 9. Intermediate leaf 10. Adult leaves

Tasmanian Alpine Yellow Gum

Eucalyptus subcrenulata Maiden & Blakely

Tasmanian alpine yellow gum is typically a small to medium-sized montane to subalpine species endemic to Tasmania and occurring on sites between the upper limits of tall closed-forests and the higher, more adverse sites where Tasmanian snow gum (*E. coccifera*) is found in almost pure stands. Commonly it is 10–20 m in height, with dbh up to 0.5 m, and trunks which are at least moderately straight. In some lower altitude, less exposed sites it attains heights greater than 50 m and dbh up to 1.5 m. Lateral branches are numerous and, in typical open situations, persistent nearly to ground level.

Tasmanian alpine yellow gum occurs in the same general area as varnished gum (*E. vernicosa*), but at lower altitudes. It is present on the high mountains and plateaux of the western and southern part of the State, with most of the area within 50–100 km of the sea, and south of latitude 43°S it approaches the coast. The upper part of the occurrence extends into the alpine zone where during winter severe frosts and snow are experienced with snow sometimes remaining on the ground for several months.

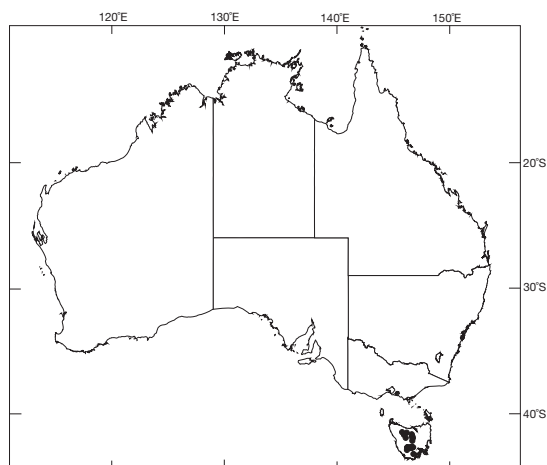
Tasmanian alpine yellow gum occurs over a wide range of topography from steep, exposed ridges through moderate slopes to plateaux and mountaintops. Soils vary from skeletal, to peaty, weakly developed soils or clayey types on favourable sites at the lower altitudes.

At the higher altitudes in montane and subalpine woodlands the most common associated eucalypt is Tasmanian snow gum (*E. coccifera*), while at the lower altitudes there are several eucalypts, e.g. alpine ash (*E. delegatensis*) and Smithton peppermint (*E. nitida*), and some rainforest species, e.g. myrtle beech (*Nothofagus cunninghamii*).

Related species: This species belongs in a small series (*Semiunicolores* Blakely) and is close to two other yellow gums endemic to Tasmania, viz. Tasmanian yellow gum (*E. johnstonii*) and varnished gum (*E. vernicosa*) (Brooker 2000). It is easily distinguished from the dwarf shrub *E. vernicosa*, which has small leaves to 2.5 cm long. It differs from the closely related, but taller *E. johnstonii* by the smaller buds and fruits and by the higher altitude habitat. There may be unpublished taxa linking the three Tasmanian species, showing a gradient in stature and bud and fruit size. Both Tasmanian alpine yellow gum and *E. johnstonii* are distinct from the other tall smooth-barked species in Tasmania, Tasmanian blue gum (*E. globulus*), by the smaller, glossy green juvenile leaves and the absence of the white wax on the buds and fruits that makes Tasmanian blue gum so distinctive. Two rare mainland mallee species, Mt Imlay mallee (*E. imlayensis*) from New South Wales and Nunniong gum (*E. elaeophloia*) from Victoria, also belong to series *Semiunicolores*.

Publication: *Crit. Revis. Eucalyptus* 8, 59 (1929). Type: Mount Field East, Tasmania, March 1906, J. H. Maiden.

Names: Botanical Latin *subcrenulatus* (subcrenulate), in reference to the edges of the juvenile leaves. Common names refer to habitat and to bark colour.



Bark: Decorticating in small plates at the base of the trunk and on the upper parts in short, irregular strips. The fresh surface is smooth, yellowish, whitish or very pale grey, often with yellowish green blotches and also with the striking orange-red patches which are a feature of the closely related *E. johnstonii*.

Leaves: Seedling Opposite, sessile or very shortly petiolate, elliptical, ovate or orbicular, slightly crenulate, 2–3 × 1.5–2.5 cm, green, discolorous. Juvenile Opposite at Prst, becoming alternate, petiolate, suborbicular to ovate, crenulate, 3–7.5 × 2.5–5 cm, green, becoming concolorous. Intermediate Alternate, petiolate, ovate to broad-lanceolate, crenulate, 6–12 × 2.5–4.5 cm, glossy green, concolorous, thick. Adult Alternate, petiolate, ovate to broad-lanceolate, crenulate, 8–11 × 1.5–3 cm, glossy green, concolorous, thick.

Inflorescences: Simple, axillary, 3-flowered; peduncles stout, angular, 0.2–0.6 cm long; pedicels absent or very short; buds ovoid, 0.6–0.8 × 0.3–0.5 cm, slightly rugose; opercula conical or hemispherical-apiculate. Flowers Mar.–May.

Fruits: Sessile, hemispherical to broadly campanulate, 0.4–0.6 × 0.6–0.8 cm, slightly rugose, sometimes ribbed; disc narrow to moderately broad, descending (can be confused with the relatively broad staminal ring); valves 3(4), varying from about rim level to distinctly exserted, often with remnants of a covering skin (pellicle). Seeds flattened-ellipsoidal, grey-black, hilum ventral.

Wood: Heartwood pale pink-brown, of moderately high density, works readily; density not known; has been used for joinery and cabinetwork, but only small quantities available.

Climate: Altitudinal range: 550–1200 m; Hottest/coldest months: 15–18°C/–1–1°C; Frost incidence: high (100 or more each year and snow at high elevations); Rainfall: 1200–2450 mm per year, uniform.

Distinctive features: A small to very tall montane to subalpine tree with stiff, glossy green adult leaves which retain a faintly crenulate margin, a prominent feature of the juvenile leaves; juvenile leaves shortly but distinctly petiolate; buds in 3s; peduncles very short; pedicels usually absent; fruits slightly rugose, with valves near rim level or exserted.



Eucalyptus subcrenulata 1. Adult leaves 2. Intermediate leaves 3. Seedling 4. Buds 5. Juvenile leaves 6. Fruits 7. Stand, near Lake Fenton, Mt Field National Park, Tas. 8. Adult leaf venation 9. Bark

Tasmanian Yellow Gum

Eucalyptus johnstonii Maiden

Tasmanian yellow gum is a tall forest tree usually up to 40 m in height, with dbh up to 1.5 m above a sometimes slightly buttressed base. Exceptional trees may reach 60 m in height and 2 m dbh. In good quality forest the trunk is straight and heavy branches form the framework of a crown of moderate size.

Tasmanian yellow gum grows on mountains and plateaux in south-eastern Tasmania, mainly within 100 km of Hobart, e.g. Florentine and Weld Valleys and Wellington Range. The distribution of Tasmanian yellow gum is in subalpine areas where snow falls during winter at all altitudes. The upper limit of altitude for this species is not easy to define due to its intergrading with other closely related species.

On the good sites the soils are mainly moderately deep clay loams; the principal rock is Triassic sandstone, underlying much-weathered shallow Jurassic dolerite.

The largest specimens grow in tall closed or open forests with several other eucalypts, mainly of the ash group, such as alpine ash (*E. delegatensis*) and messmate (*E. obliqua*), but also with urn gum (*E. urnigera*), Smithton peppermint (*E. nitida*) and Tasmanian snow gum (*E. coccifera*). There may be localised association with rainforest trees such as celery top pine (*Phyllocladus aspleniifolius*) and myrtle beech (*Nothofagus cunninghamii*).

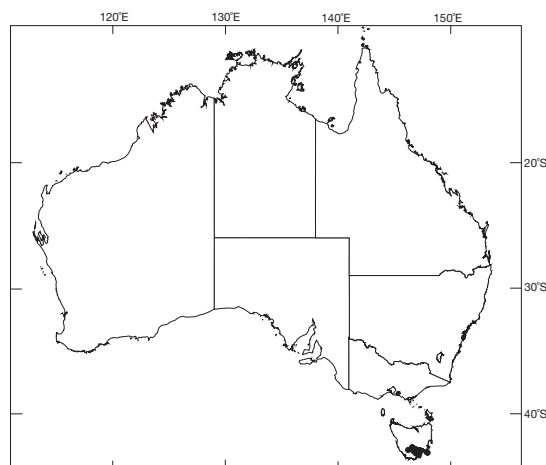
Related species: Tasmanian yellow gum belongs in a small series (*Semiunicolores* Blakely) and is close to two other yellow gums, viz. alpine yellow gum (*E. subcrenulata*) and varnished gum (*E. vernicosa*) (Brooker 2000). It is easily distinguished from the dwarf shrub *E. vernicosa*, which has small leaves to 2.5 cm long. Tasmanian yellow gum differs from *E. subcrenulata* by the taller stature, larger buds and fruits and by the lower altitude habitat. There may be unpublished taxa linking the three Tasmanian species, showing a gradient in stature and bud and fruit size. Both Tasmanian yellow gum and *E. subcrenulata* are distinct from the other tall smooth-barked species in Tasmania, Tasmanian blue gum (*E. globulus*), by the smaller, glossy green juvenile leaves and the absence of the white wax on the buds and fruits that makes Tasmanian blue gum so distinctive. Two rare mainland mallee species, Mt Imlay mallee (*E. imlayensis*) from New South Wales and Nunniong gum (*E. elaeophloia*) from Victoria, also belong to series *Semiunicolores*.

Publication: *Crit. Revis. Eucalyptus* 6, 280 (1922). Type: From Ōa saddle of the Dividing Range between the Huon and Derwent watersheds, Tasmania. ♂ collector unknown.

Names: Botanical honours R.M. Johnston (1845–1918), a geologist and keen amateur botanist in Tasmania. Common refers to the bark colour (at certain times).

Bark: Usually decortivating to near ground level in long, thin strips, leaving a smooth surface, which is streaked orange-red or yellow-green when freshly exposed. When the trunks are wet these colours are quite vivid and assist in identification.

Leaves: Seedling opposite, sessile or very shortly petiolate, amplexicaul, ovate to orbicular, 2.5–4.5 × 2–4.5 cm, dark



green, glossy, discolorous. Juvenile alternate, shortly petiolate, orbicular (often broader than long), 4.5–6 × 4.5–5.5 cm, dark green, glossy, slightly discolorous at first, later leaves concolorous. Intermediate alternate, petiolate, ovate to broad-lanceolate, 6–17 × 3–4.5 cm, glossy green, concolorous. Adult alternate, petiolate, broad-lanceolate to lanceolate, 8–12 × 2–3 cm, glossy green, concolorous. Leaves at all stages somewhat crenulate.

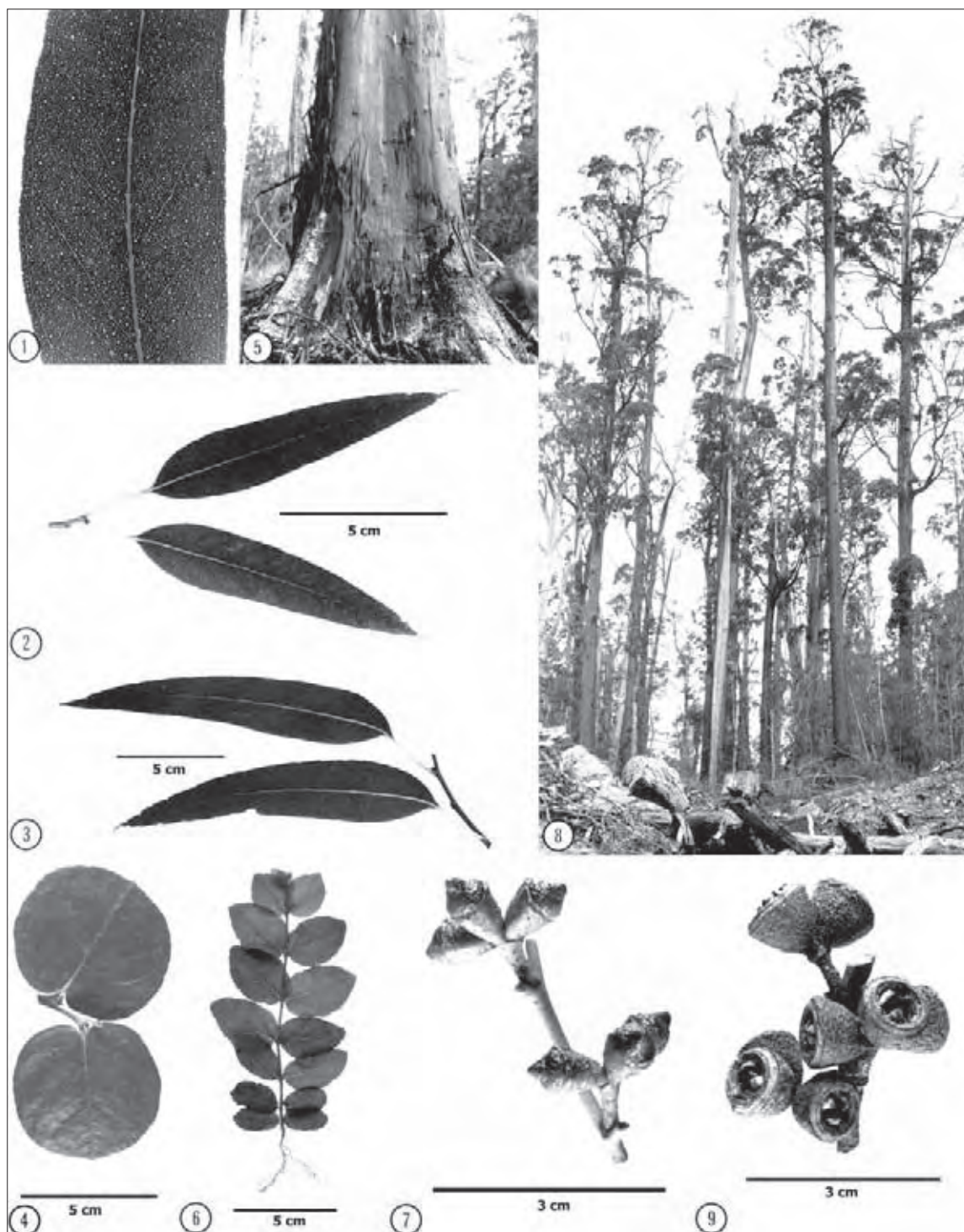
Inflorescences: Simple, axillary, 3-flowered; peduncles stout, angular, 0.3–0.9 cm long; pedicels absent or very short; buds more or less ovoid, 0.7–1.2 × 0.4–0.9 cm, more or less rugose and often with distinctly 2-ribbed hypanthia; opercula conical or flattened with a rounded central knob. Flowers Jan.–Jul.

Fruits: Sessile, more or less hemispherical, 0.7–0.8 × 0.9–1.3 cm, often rugose and faintly 2-ribbed; disc broad, more or less level to slightly ascending; valves 3 or 4, broad, exserted, often partially covered with a skin (pellicle). Seeds flattened-ellipsoidal, grey-black, hilum ventral.

Wood: Heartwood pale yellow-brown with slight pinkish tinge, moderately high density, works easily; has been used for joinery and cabinetwork, and suitable for piles.

Climate: Altitudinal range: 350–900 m; Hottest/coldest months: 15–19°C/0–4°C; Frost incidence: high (about 50–90 each year and snow at high elevations); Rainfall: 980–1600 mm per year, uniform.

Distinctive features: Usually a tall forest tree with shining green leaves having crenulate edges even in the adult foliage; juvenile leaves shortly but distinctly petiolate; bark colourful, especially when wet; buds and fruits in 3s; peduncles short, stout; pedicels absent or, in the central bud and fruit, very short; fruits moderately large, with exserted valves and faint ribs.



Eucalyptus johnstonii 1. Adult leaf venation 2. Adult leaves 3. Intermediate leaves 4. Juvenile leaves 5. Bark 6. Seedling 7. Buds 8. Stand, west of Judbury, Tas. 9. Fruits

Gully Gum Gully Peppermint (N.S.W.), Blackbutt Peppermint (N.S.W.)

Eucalyptus smithii R. T. Baker

Gully gum is a tall tree on optimum sites under good forest conditions, attaining 40–45 m in height and 1–1.5 m dbh with a long, well-shaped trunk. On marginal sites and in open situations it may be more heavily branched with a short, stout bole and only 10–20 m tall. The canopy often has conspicuous hanging ribbons of partly decorticated bark. A mallee form has been recorded from several localities.

Gully gum occurs on the eastern edges of the southern end of the Central and Southern Tablelands and on the adjacent coastal escarpment and lowlands of south-eastern New South Wales, south from Yerranderie; also eastern Victoria, e.g. south of the Howe Range, while mallee forms occur at Little River Gorge, Mt Dawson, and Black Range east of Mt Useful.

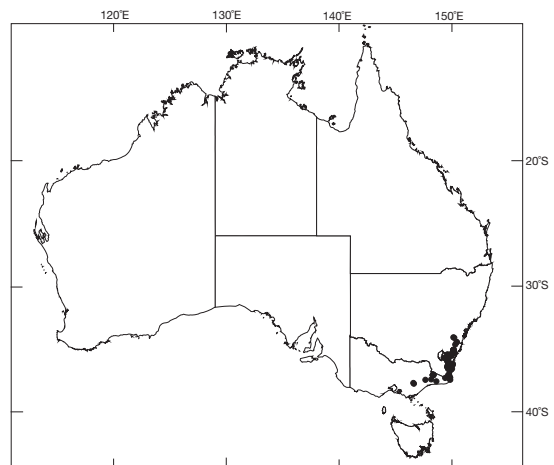
This species occurs on the lower slopes of hills and on small stream flats and around the edges of swamps in rolling and hilly tablelands; also on flats and low slopes near streams of the coastal area. In some localities it occurs notably on the scarps, the bases of cliffs, and upper slopes of dry and exposed sandstone ridges. Gully gum prefers clay loams or deep sandy loams over clays which do not become very dry, but it will grow on a wide range of soils derived from sedimentary or volcanic rocks if they are moderately fertile. Poorer sites are often sand over sandstone or conglomerate.

The best stands of gully gum occur in tall open forests. Other eucalypts present may include yellow stringybark (*E. muelleriana*), messmate (*E. obliqua*), brown barrel (*E. fastigata*), narrow-leaved peppermint (*E. radiata*), silvertop ash (*E. sieberi*), spotted gum (*E. maculata*) and white stringybark (*E. globoidea*). It may also be associated with river peppermint (*E. elata*) and swamp gum (*E. ovata*).

Related species: Brooker (2000) placed gully gum in series *Compactae*, recognised by the hard, dark-coloured, compacted rough bark, and it is the only species in subseries *Arrectae*. Gully gum has a combination of character states that suggests it does not have close affinities with other species. The bark type is seen as well in subgenus *Eucalyptus* in river peppermint (*E. elata*), silvertop ash (*E. sieberi*) and black sallee (*E. stellulata*). The series *Compactae* consists of the 7-flowered gully gum and the 3-flowered Big Badja gum (*E. badjensis*), both of which are similar habit, ribbony bark in the crown, the many pairs of green juvenile leaves and the narrow, green adult leaves. River peppermint also resembles gully gum in the field but is easily distinguished by the multi-flowered inflorescences and the strong smell of the crushed leaves.

Publication: *Proc. Linn. Soc. N.S.W.* 24, 292 (1899). Type: Sugarloaf Mountain near Braidwood, New South Wales, Aug. 1898, W. Baeuerlen.

Names: Botanical honours H.G. Smith (1852–1924), a chemist with the Sydney Technological Museum who worked on the essential oils of Australian flora for many years. Common refers to habitat (although it is by no means confined to gully sites).



Bark: Rough and persistent over most of the trunk, grey or dark brown, moderately thick, compact with narrow longitudinal fissures, decorticate above in long ribbons which often remain hanging in the canopy, exposing smooth, white or creamy white bark. Small trees or mallee forms may be entirely smooth-barked.

Leaves: Seedling opposite for many pairs, sessile, amplexicaul, broad-lanceolate to lanceolate, 4–8 × 0.7–1.3 cm, green, discolorous. Juvenile opposite, sessile, amplexicaul, lanceolate, 6–10 × 1–1.6 cm, green, discolorous; stems sometimes slightly pruinose. Adult alternate, petiolate, narrow-lanceolate, 10–20 × 0.7–1.5 cm, green, concolorous.

Inflorescences: Simple, axillary, 7-flowered; peduncles angular or flattened, 0.5–1.2 cm long; pedicels 0.2–0.6 cm long; buds ovoid or clavate, 0.6–0.7 × 0.3–0.4 cm, sometimes slightly pruinose; opercula conical, hemispherical-apiculate or rostrate. Flowers Jan.–Mar.

Fruits: Pedicellate, globular or ovoid (including the disc), 0.4–0.7 × 0.5–0.7 cm; disc broad, ascending; valves usually 3, short, broad, exserted. Seeds flattened-ellipsoidal, brown-black, hilum ventral.

Wood: Sapwood susceptible to attack by *Lyctus* borers; heartwood pale, close-grained, interlocked, hard, moderately durable; density not known but 13-year-old trees cultivated near Canberra had a basic density of 550 kg m⁻³, used to a limited extent for general construction purposes and has potential as pulpwood.

Climate: Altitudinal range: 50–1150 m; Hottest/coldest months: 21–27°C/–2–6°C; Frost incidence: low to high (up to 100 or more each year at high elevations); Rainfall: 700–1350 mm per year, uniform to summer max.

Distinctive features: Usually a tree of good form with persistent, dark and compact lower bark with irregular, narrow longitudinal fissures; ribbons of decorticated upper bark often remain hanging in the canopy; juvenile leaves opposite, sessile and lanceolate for many pairs; buds in 7s; fruits with broad, steeply ascending disc.



Eucalyptus smithii 1, 7. Bark 2. Adult leaves 3. Intermediate leaves 4. Seedling 5. Juvenile leaves 6. Buds 8. Fruits 9. Tree, Bodalla State Forest, west of Dalmeny, N.S.W. 10. Adult leaf venation

Big Badja Gum

Eucalyptus badjensis Beuzev. & Welch

Big Badja gum is a tall tree up to 45 m in height and 1.5 m dbh, with a straight stem clear of branches for up to three-quarters of the tree height under optimum conditions. The crown is of moderate size and rather open in mature specimens. On poorer sites the tree may be less than 25 m in height, with a trunk of only moderate form.

Big Badja gum has a restricted natural occurrence in south-eastern New South Wales on the relatively high country of the eastern edges of the Southern Tablelands and particularly the coastal escarpment including Brown Mountain and as far south as Mt Darragh. The distribution is in areas where snowfalls during winter can be expected.

The topography consists of the gentle slopes of tablelands, the upper slopes of steep hillsides and the headwaters of small rivers. Apart from good forest clay loams on the better sites, the soils are mainly stony or gravelly with poor differentiation into horizons.

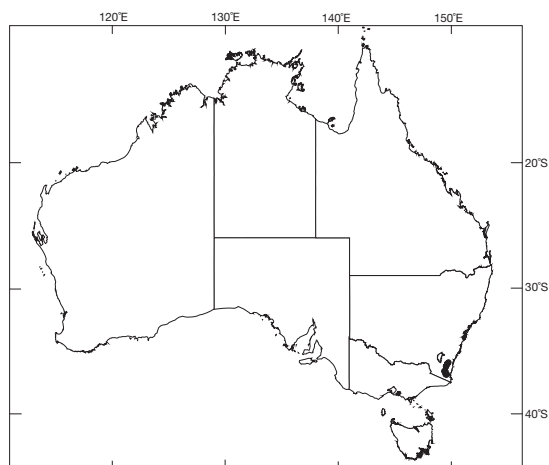
At its best this tree grows in tall open forests with brown barrel (*E. fastigata*), messmate (*E. obliqua*) and shining gum (*E. nitens*). On some sites it may be closely associated with large specimens of river peppermint (*E. elata*) and on adjacent but somewhat better-drained sites there may be narrow-leaved peppermint (*E. radiata* subsp. *robertsonii*), silvertop ash (*E. sieberi*) and gully gum (*E. smithii*). In forest openings in the higher rainfall areas there are often one or more acacias, e.g. silver wattle (*A. dealbata*). In the southernmost locality it grows with *E. fastigata*, mountain grey gum (*E. cypello-carpa*) and swamp gum (*E. ovata*).

Related species: Brooker (2000) placed Big Badja gum in series *Compactae*, recognised by the hard, dark-coloured, compacted rough bark. This bark type is seen as well in subgenus *Eucalyptus* in river peppermint (*E. elata*), silvertop ash (*E. sieberi*) and black sallee (*E. stellulata*). The series *Compactae* consists of the 3-flowered *E. badjensis* and the 7-flowered gully gum (*E. smithii*), both of which species are similar in distribution, habit, ribbony bark in the crown, the many pairs of green juvenile leaves and the narrow, green adult leaves. River peppermint also resembles Big Badja gum in the field but is easily distinguished by the multi-flowered inflorescences and the strong smell of the crushed leaves. The best-known and widespread 3-flowered species with many pairs of green juvenile leaves is manna gum (*E. viminalis*), which differs by the smooth or non-compact rough bark, the larger adult leaves, the longer peduncles to 0.8 cm long, and the larger, non-campanulate fruits.

Publication: *J. Proc. Roy. Soc. N.S.W.* 58, 177 (1924). Type: South of Big Badja Mountain, New South Wales, Jan. 1924, W.A.W. de Beuzeville.

Names: Botanical and common both refer to the area where the type specimen was collected.

Bark: Rough and persistent on the lower part of the trunk, compact, moderately thin, hard, decortivating above in thin strips to leave a smooth, whitish, greenish to light brownish grey surface. Ribbons of bark usually hang in the canopy.



Leaves: Seedling—opposite for many pairs, sessile, sometimes amplexicaul, broad-lanceolate to lanceolate, 4.5–6.5 × 0.8–1.7 cm, green, discolorous. Juvenile—opposite, sessile, sometimes amplexicaul, broad-lanceolate to lanceolate, 6.5–8 × 1.7–2 cm, green, slightly discolorous. Intermediate—alternate, petiolate, narrow-lanceolate 1.5–2.5 × 1.5–2.3 cm, green, concolorous. Adult—alternate, petiolate, narrow-lanceolate, 8.5–18 × 0.7–1.5 cm, green, concolorous.

Inflorescences: Simple, axillary, 3-flowered; peduncles angular, 0.3–0.4 cm long; pedicels usually absent or occasionally to 0.1 cm long; buds ovoid, 0.4–0.6 × 0.2–0.3 cm; opercula conical. Flowers Dec.–Feb.

Fruits: Sessile, campanulate, bared at the rims, 0.3–0.5 × 0.35–0.55 cm; disc moderately broad, more or less level or ascending; valves 3 or 4, strongly exerted. Seeds flattened-ellipsoidal, grey-brown, hilum ventral.

Wood: Sapwood wide, pale; heartwood pale red, with distinct growth rings, small black stains may be present, durability probably low; density and uses not known but 13-year-old trees cultivated near Canberra had a basic density of 500 kg m⁻³ and had favourable pulpwood qualities.

Climate: Altitudinal range: 750–1200 m; Hottest/coldest months: 21–24°C/4–1°C; Frost incidence: high (up to 100 each year and snow at highest elevations); Rainfall: 800–1250 mm per year, uniform.

Distinctive features: A tree with thin, compact rough bark retained at the base, smooth above; adult leaves notably long and narrow and distinct from other trees which grow in the same area, except *E. elata*; juvenile leaves opposite, sessile, lanceolate and somewhat like those of *E. viminalis*; 3-flowered inflorescences with very short peduncles; buds small, mostly sessile; fruits with bared rims, and 3 or 4 strongly exerted valves.



Eucalyptus badjensis 1. Buds 2. Adult leaves 3. Intermediate leaves 4. Seedling 5. Fruits 6. Adult leaf venation 7. Tree, Brown Mountain, between Nimmitabel and Bega, N.S.W. 8. Bark

Manna Gum Ribbon Gum (N.S.W.), White Gum (N.S.W. and Tas.)

Eucalyptus viminalis Labill.

Manna gum is a species of very variable habit. Commonly it is a tall tree, 30–50 m in height and up to 1.5 m dbh. In Tasmania under favourable conditions it may occasionally attain 90 m in height and 3 m dbh. On drier sites it may be a smaller, umbrageous tree 10–20 m tall. The canopy often has conspicuous ribbons of partly decorticated bark. There are three subspecies, the typical, subsp. *pryoriana* and subsp. *cygnetensis*.

In New South Wales subsp. *viminalis* is found in high country north as far as the southern part of the Northern Tablelands. In Victoria it is widespread and common in mountains and foothills both north and south of the Great Dividing Range. It is common in the north-east and eastern half of Tasmania and on King and Flinders Islands in Bass Strait. In South Australia it occurs in the central part of the Mt Lofty Range. Subsp. *pryoriana* occurs in southern Victoria from the Bellarine Peninsula east to about Lake Tyers. Subsp. *cygnetensis* occurs near Anglesea and Cape Otway, the Grampians and south-western Victoria to adjacent parts of the south-east of South Australia, Mt Lofty Range and on southern Eyre Peninsula and Kangaroo Island.

This species grows on coastal flats to mountains and tablelands, but shows best development in valleys of hilly and mountainous country. Subsp. *viminalis* prefers moist but well-drained alluvial or sandy loam soils with clay subsoils and attains its best development in tall open forests. Subsp. *cygnetensis* can occur on sandy soils along creeks but also on heavier soils of the Mt Lofty Range and on limestone on lower Eyre Peninsula. Subsp. *pryoriana* occurs exclusively in sandy coastal heath regions.

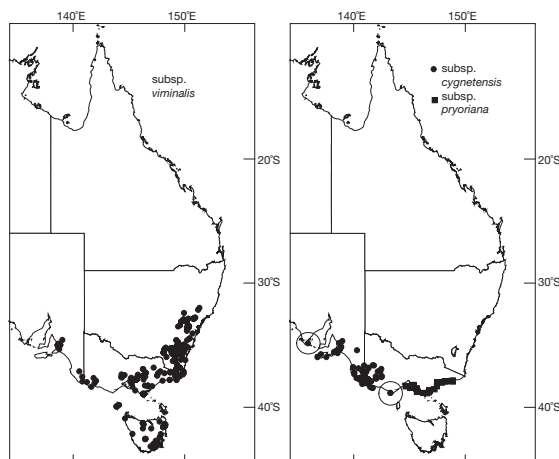
Manna gum is associated with very many eucalypts, including ashes, gums and peppermints.

Related species: Brooker (2000) placed manna gum in series *Viminales*, subseries *Lanceolatae*. It resembles mountain gum (*E. dalrympleana*), which usually occurs at higher altitudes in the same mountain ranges but has pale green, orbicular juvenile leaves. The more northerly white gum (*E. nobilis*) is closely related to manna gum but differs in having buds in 7s and broad-lanceolate, glossy, green juvenile leaves.

Publication: Subsp. *viminalis*: *Nov. Holl. Pl.* 2, 12 (1806). Type: Tasmania (? Recherche Bay), (1793), J. Labillardiere. Subsp. *pryoriana* (L.A.S. Johnson) Brooker & Slee: *Muelleria* 9, 80 (1996). Type: Port Phillip, Victoria, Feb. 1880, ?F. von Mueller. Subsp. *cygnetensis* Boomsma: *J. Adel. Bot. Gard.* 2, 295 (1980). Type: Cygnet River, Kangaroo Island, South Australia, 10 Dec. 1979, R.C. Hagerstrom & C. Boomsma.

Names: Botanical Latin *viminalis* (bearing long flexible twigs, osier-bearing), supposedly refers to a resemblance of the adult leaves to those of the osier willow; *pryoriana*, after L.D. Pryor (1915–1998), renowned eucalypt botanist; *cygnetensis*: after the Cygnet River, Kangaroo Island. Common Manna is a white sugary sap from a predatory insect.

Bark: Almost wholly smooth, or rough, grey and persistent on the lower part of the trunk, shed in long ribbons from the



upper trunk and branches, or with a rough basal stocking (*viminalis*); rough over most of trunk (*pryoriana*, *cygnetensis*).

Leaves: Seedling—opposite for many pairs, sessile, sometimes amplexicaul, broad-lanceolate or lanceolate, 3.5–8.5 × 0.8–2 cm, green, slightly discolorous. Juvenile—opposite, sessile, sometimes amplexicaul, broad-lanceolate or lanceolate, 6.5–15 × 2–3.5 cm, green, slightly discolorous. Intermediate—alternate, petiolate, broad-lanceolate to narrow-lanceolate, 12–32 × 2–6 cm, green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 12–20 × 0.8–2.5 cm, green, concolorous.

Inflorescences: Simple, axillary, 3-flowered (*viminalis*, *pryoriana*), 7-flowered (*cygnetensis*); peduncles angular to flattened, 0.4–1 cm long; pedicels absent or up to 0.4 cm long; buds ovoid, 0.7–1 × 0.4–0.5 cm; opercula conical or hemispherical-apiculate. Flowers Jan.–May.

Fruits: Sessile or shortly pedicellate, globular to truncate-ovoid, 0.5–0.8 × 0.6–0.8 cm; disc broad, ascending; valves 3 or 4, short, broad, exserted. Seeds flattened-ellipsoidal, brown to blackish, hilum ventral.

Wood: Sapwood pale, readily distinguishable, susceptible to attack by *Lyctus* borers; heartwood light pink or pale yellow, with straight and open grain, coarse-textured, not very strong and not durable; density about 530–870 kg m⁻³; used for building framing, flooring, panelling, joinery and pulp for container board. The wood is similar in appearance to alpine ash (*E. delagatensis*) although slightly darker.

Climate: Altitudinal range: sea level to 1300 m (*viminalis*), sea level to 450 m (*cygnetensis*), sea level to 150 m (*pryoriana*); Hottest/coldest months: 18–30°C/–3–7°C (*viminalis*), 21–27°C/4–7°C (*cygnetensis*), 25–27°C/4–6°C (*pryoriana*); Frost incidence: low to high with up to 100 each year at high elevations (*viminalis*), low to moderate (*cygnetensis*, *pryoriana*); Rainfall: 500–1700 mm per year, uniform to winter max. (*viminalis*), 400–1200 mm per year (*cygnetensis*), 650–1000 mm per year (*pryoriana*) winter max.

Distinctive features: Tall forest or woodland tree; juvenile leaves opposite and sessile for many pairs; 3-flowered (*viminalis*, *pryoriana*), 7-flowered (*cygnetensis*).



Eucalyptus viminalis subsp. *viminalis* 1. Buds 2. Fruits 3. Seedling 4. Juvenile leaves 5. Adult leaves 6. Trees, north-west of Braidwood, N.S.W. 7, 10. Bark 8. Adult leaf venation 9. Tree, north of Club Terrace, Vic.

White Gum Giant White Gum, Northern Tablelands Manna Gum

Eucalyptus nobilis L.A.S. Johnson & K.D. Hill

White gum is a medium-sized to very tall tree up to 70 m in height with a dbh up to 1 m. The tree is usually erect and branches at about half tree height to form a crown comprising relatively large green leaves. Some trees of white gum are exceptionally tall. A tree in the Styx River State Forest was measured at 79.2 m tall.

This species extends south from south-eastern Queensland (e.g. Cunninghams Gap, Pozieres, Tannymorel), to the Northern Tablelands in New South Wales, particularly along its eastern escarpment (e.g. Point Lookout, Yarrowditch), and west to the Liverpool Range east of Tamworth. Populations of white gum were previously considered to represent the northern form of manna gum (*E. viminalis*).

White gum often occurs along riverbanks and river flats. Soils are alluvial and tend to be deep and relatively fertile. They include deep, dark brown, clay loams derived from basalt. Soils may also be derived from conglomerate or meta-sedimentary rocks.

Vegetation structure ranges from tall open forests to grassy woodlands. Associated species in the east of its range include messmate (*E. obliqua*), Sydney blue gum (*E. saligna*), narrow-leaved peppermint (*E. radiata*), brown barrel (*E. fastigata*), tallowwood (*E. microcorys*), New England blackbutt (*E. andrewsii*) or negrohead beech (*Nothofagus moorei*); while Blakely's red gum (*E. blakelyi*), apple box (*E. bridgesiana*), Cameron's stringybark (*E. cameronii*) and river oak (*Casuarina cunninghamiana*) are among species present in the western parts of its range.

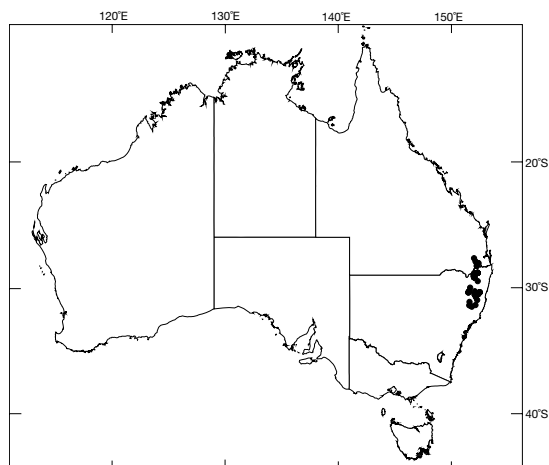
Related species: White gum is one of the few species in series *Viminales*, subseries *Lanceolatae*, diagnosed by the prominent narrow, opposite, green juvenile leaves (Brooker 2000). It is related to the widespread manna gum (*E. viminalis*), from which it differs by the consistently smooth bark, rarely rough at the base like forms of manna gum, its normally long, straight trunk, the larger juvenile leaves and the 7-flowered inflorescences. As a tree it may be confused with mountain gum (*E. dalrympleana*), which differs in the round juvenile leaves. Another white gum of the Northern Tablelands is brittle gum (*E. elliptica*), which is of much lower stature with roundish, pruinose juvenile leaves. It may also be confused with Dorrigo white gum (*E. dorrigoensis*) which is distinguished by its pruinose, ovate to broad-lanceolate, blue-green juvenile leaves, the mostly dull adult leaves and its inflexed stamens.

Publication: *Telopea* 4, 59 (1990). Type: Northern Tablelands, New South Wales, 17 km north-west of Nowendoc on the main divide, 23 April 1984, L. Johnson 9021.

Names: Botanical Latin *nobilis* (noble, excellent), referring to the tall, straight habit.

Bark: Smooth over whole trunk and branches, or with persistent slabs of rough bark at the base, grey or whitish, shedding in long ribbons.

Leaves: Seedling opposite for many pairs, sessile, broad-lanceolate to ovate, 5.9 × 1.5–2.5 cm, glossy green, discolorous. Juvenile opposite, sessile, broad-lanceolate to



ovate, often down-curved, 5.15 × 1.4–6.5 cm, green. Adult alternate, petiolate, lanceolate to narrow-lanceolate, margins sometimes notably undulate, 8.21 × 1.3 cm, glossy green, concolorous.

Inflorescences: Simple, axillary, 7-flowered; peduncles slightly flattened, 0.6–1.2 cm long; pedicellate; buds ovoid to fusiform, more or less 1 × 0.5 cm; opercula conical or hemispherical. Flowers Jan.–May.

Fruits: Shortly pedicellate, cupular or hemispherical, 0.6–0.8 × 0.5–0.9 cm; disc slightly ascending; valves 3 or 4, slightly exserted. Seeds compressed-ovoid, brown or black, hilum ventral.

Wood: Properties probably similar to manna gum which has pale sapwood pale, susceptible to attack by *Lyctus* borers; pale yellow heartwood, not very strong and not durable; density about 730 kg m⁻³; used for building framing, flooring, panelling. Formerly harvested and marketed as manna gum.

Climate: Altitudinal range: 540–1300 m; Hottest/coldest months: 22–28°C/1–4°C; Frost incidence: high; Rainfall: 700–1400 mm per year, summer max.

Distinctive features: Medium-sized to very tall tree with smooth white bark over whole trunk, sometimes with rough basal bark; juvenile leaves opposite, sessile, for many pairs, broad-lanceolate to lanceolate, green; adult leaves with margins sometimes notably undulate; buds in 7s.



Eucalyptus nobilis 1. Bark 2. Adult leaves 3. Buds 4, 8. Trees, Styx River State Forest, N.S.W. 5. Intermediate leaves 6. Fruits 7. Seedling 9. Juvenile leaves 10. Adult leaf venation

Mountain Gum White Gum, Broad-leaved Ribbon Gum

Eucalyptus dalrympleana Maiden

Mountain gum is mostly a tall to very tall tree up to 40 m in height and 101.5 m dbh, but under favourable conditions it may exceed 60 m with a dbh over 2 m. On elevated plateaux with poor drainage it may occur as a small to medium-sized tree. It usually has a straight trunk with a moderately large, somewhat open-branched crown. There are two subspecies, the typical and subsp. *heptantha*.

Typical mountain gum occurs in the mountain forests of the steep upper slopes of the Australian Alps in Victoria and New South Wales and on the Southern and Central Tablelands of the latter State. In Tasmania it is fairly common in the hilly and mountainous parts of the central plateau and in the north-east. In South Australia it occurs in the Mt Lofty Range from Lobethal southwards. The altitudinal range on the mainland is around 500–1700 m and in Tasmania 300–900 m. Subsp. *heptantha* is restricted to the Northern Tablelands of New South Wales, south from Wilson's Downfall near the Queensland border. In southern parts, e.g. Tomalla Tableland, Barrington Tops and the high western end of the Liverpool Range, both 3 and 7-flowered forms are found, being intergrades between the two subspecies.

This species occurs on a wide variety of soil types from sandy to heavy clay soils over granite, sandstone, dolerite and shales. Best development is on deep, red or red-brown loams, with clay subsoil.

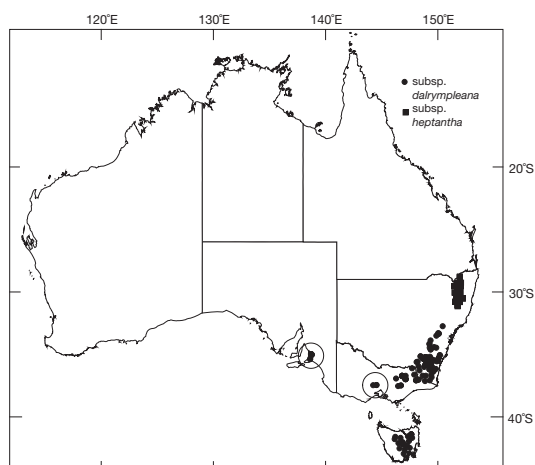
Mountain gum typically occurs in tall open forests. Associated eucalypts may include snow gum (*E. pauciflora*) and alpine ash (*E. delegatensis*) at the higher altitudes, with brown barrel (*E. fastigata*), manna gum (*E. viminalis*), peppermints (*E. radiata*, *E. dives*), candlebark (*E. rubida*), brittle gum (*E. mannifera*), swamp gum (*E. ovata*) and black sallee (*E. stellulata*) elsewhere.

Related species: Brooker (2000) placed mountain gum with candlebark (*E. rubida*) in series *Viminalis*, subseries *Circulares*, which is diagnosed by the orbicular juvenile leaves compared with the lanceolate leaves of manna gum (*E. viminalis*). Candlebark (*E. rubida*) occupies poorer sites of heavy, infertile soils and is easily recognised by the conspicuous round, pruinose juvenile leaves of regrowth.

Publication: Subsp. *dalrympleana*: *Forest Fl. N.S.W.* 7, 137 (1920). Type: Peppercorn Plain, Yarrangobilly, New South Wales, Jan. 1920, W.A.W. de Beuzeville. Subsp. *heptantha* L.A.S. Johnson: *Contr. New South Wales Nat. Herb.* 3, 110 (1962). Type: Wandsworth to Moredun Creek, New South Wales, above 3000 feet, 23 May 1957, L.A.S. Johnson.

Names: Botanical *dalrympleana*: honours Richard Dalrymple Hay (1861–1943), a former Chief Commissioner of Forests for New South Wales; *heptantha*: Greek *hept* (seven) and *anthos* (flowered). Common refers to habitat.

Bark: Most trees retain a metre or so of rough, greyish bark at the base, the remainder is smooth yellowish white, with irregular blotches of grey and white and occasionally pink, green and olive, often very colourful in summer or after rain.



Leaves: Seedling \bar{N} opposite for many pairs, sessile, ovate to orbicular, 2.5–4.5 \times 1–4.5 cm, pale green, concolorous. Juvenile \bar{N} opposite, sessile, amplexicaul, orbicular at \bar{P} rst, 3.5–12 \times 3–7 cm, pale green, concolorous. Adult \bar{N} alternate, petiolate, lanceolate to narrow-lanceolate, 9.5–21 \times 1.1–2.5 cm, glossy, green, concolorous, often undulate.

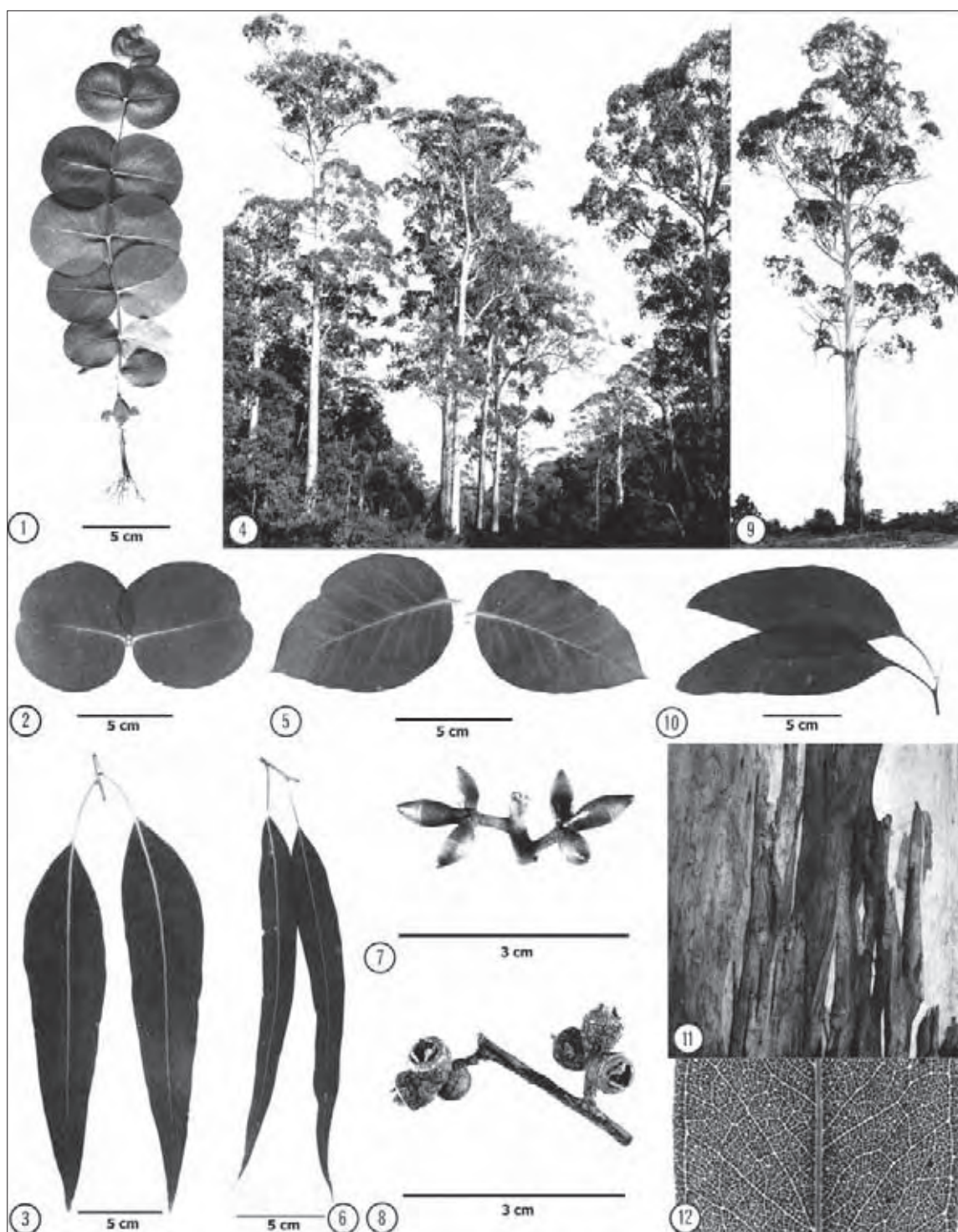
Inflorescences: Simple, axillary, 3-flowered (*dalrympleana*), 7-flowered (*heptantha*); peduncles fairly stout, angular to slightly flattened, 0.3–0.8 cm long; pedicels absent or 0.1–0.4 cm long; buds ovoid, 0.6–0.8 \times 0.3–0.5 cm; opercula conical to occasionally almost hemispherical. Flowers Mar.–May.

Fruits: Sessile or shortly pedicellate, hemispherical or ovoid (including the disc), sometimes campanulate, 0.5–0.8 \times 0.5–0.9 cm; disc moderately broad, ascending or more or less level; valves 3(4), slightly to distinctly exerted. Seeds flattened-ellipsoidal, brown to blackish, hilum ventral.

Wood: Sapwood not easily distinguished, susceptible to attack by *Lyctus* borers; heartwood straw-coloured to pink, growth rings clearly defined, moderately coarse-textured, generally straight-grained, of moderate strength and hardness but of low durability; density 482–775 kg m⁻³; used for framing, flooring, panelling, joinery and handles. Wood is similar to manna gum (*E. viminalis*).

Climate: Altitudinal range: 300–1700 m (*dalrympleana*), 900–1250 m (*heptantha*); Hottest/coldest months: 16–30°C/–3–4°C (*dalrympleana*), 22–26°C/–1–1°C (*heptantha*); Frost incidence: high, with around 60–100 each year and snow at high elevations (*dalrympleana*, *heptantha*); Rainfall: 550–1900 mm per year (*dalrympleana*), 800–1100 mm per year (*heptantha*) winter–spring to uniform.

Distinctive features: A mountain gum; seedling and juvenile leaves ovate or orbicular, pale green, opposite and sessile for many pairs; buds in 3s (*dalrympleana*) or 7s (*heptantha*); adult leaves shiny, undulate, green.



Eucalyptus dalrympleana subsp. *dalrympleana* 1. Seedling 2. Early juvenile leaves 3. Intermediate leaves 4, 9. Stand and tree, between Brindabella and Tumut, N.S.W. 5. Later juvenile leaves 6. Adult leaves 7. Buds 8. Fruits 10. Juvenile/intermediate transition leaves 11. Bark 12. Adult leaf venation

Candlebark Ribbon Gum, White Gum

Eucalyptus rubida Deane & Maiden

Candlebark at its best attains 30–40 m in height and 1 m dbh, with a clear straight trunk to two-thirds of the total height. On many sites, however, it is a rather poorly formed tree 10–20 m in height. There are two subspecies, the typical and subsp. *barbigerorum*.

Typical candlebark has an extensive geographic range in south-eastern Australia from Tasmania to the Northern Tablelands of New South Wales. The main occurrence is in New South Wales, where it is common on the tablelands and the upper western slopes, and in Victoria, where it occurs on the foothills of the Australian Alps and the western extension of the Great Dividing Range. In Tasmania it is found mainly on the lower and intermediate slopes of the central plateau. Subsp. *barbigerorum* is restricted to the Glen Innes–Guyra–Tingha districts of the Northern Tablelands of New South Wales.

Candlebark is mainly a species of tablelands, hills and mountain slopes, occurring on a wide range of soil types including those that are rather dry and shallow, almost skeletal. Best development is on moderately fertile, well-drained loams with clay subsoil.

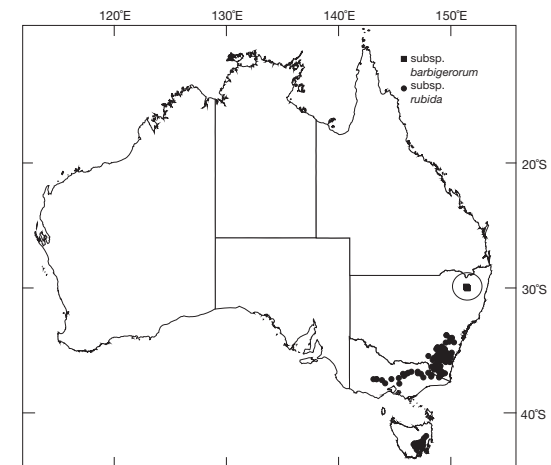
Candlebark occurs mainly in grassy woodlands or sometimes open forests. Associated eucalypt species include manna gum (*E. viminalis*), mountain gum (*E. dalrympleana*), black gum (*E. aggregata*), snow gum (*E. pauciflora*), swamp gum (*E. ovata*), apple box (*E. bridgesiana*) and messmate stringybark (*E. obliqua*).

Related species: Brooker (2000) placed candlebark with mountain gum (*E. dalrympleana*) in series *Viminalis*, subseries *Circulares*, a subseries diagnosed by the orbicular juvenile leaves. Mountain gum is a tall tree of relatively fertile sites with pale green, non-pruinose juvenile leaves and larger green, usually undulate adult leaves. Candlebark occupies poorer sites and is easily recognised by the conspicuous round, pruinose juvenile leaves of regrowth. The adult leaves are small and green to slate grey. *E. rubida* subsp. *canobolensis* (Hill and Johnson 1991), raised to species rank by Hunter (1998), differs by the conspicuous silvery crown of larger adult leaves and the much larger juvenile leaves and is restricted to basaltic soils on upper Mt Canobolas near Orange in central western New South Wales.

Publication: Subsp. *rubida*: *Proc. Linn. Soc. N.S.W.* 24, 456 (1899). Type: Jindabyne, New South Wales, Jan. 1898, J. H. Maiden; Subsp. *barbigerorum* L.A.S. Johnson & K.D. Hill: *Telopea* 4, 240 (1991). Type: Northern Tablelands, 14.1 km from Wandsworth towards Tingha, New South Wales, 29 Aug. 1986, K.D. Hill 2117.

Names: Botanical Latin *rubidus* (red), refers to seasonally red patches of bark, Latin *barbigerorum* (of the bearded ones), alludes to the bearded pioneers of early European settlement. Common refers to the smooth bark appearance.

Bark: Smooth bark (*rubida*) or with a basal rough stocking (*barbigerorum*), decorticating in strips or large elongated reddish slabs; the colour of the smooth bark is generally white, but during some of the year can have very colourful pink, red and greyish blue patches. Horizontal, black marks are often



present on the trunk, believed to be damage by burrowing insect larvae.

Leaves: Seedling—opposite for many pairs, sessile, amplexicaul, orbicular to ovate, 2.5–3.5 × 4–5 cm (usually broader than long), pruinose, greyish blue, concolorous. Juvenile—opposite, sessile, orbicular to ovate, 3–14 × 3–8 cm, pruinose, greyish blue, concolorous. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 13–18 × 2–4 cm, green or slate grey, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 9–15 × 0.8–2.4 cm, glossy, green or slate grey, concolorous.

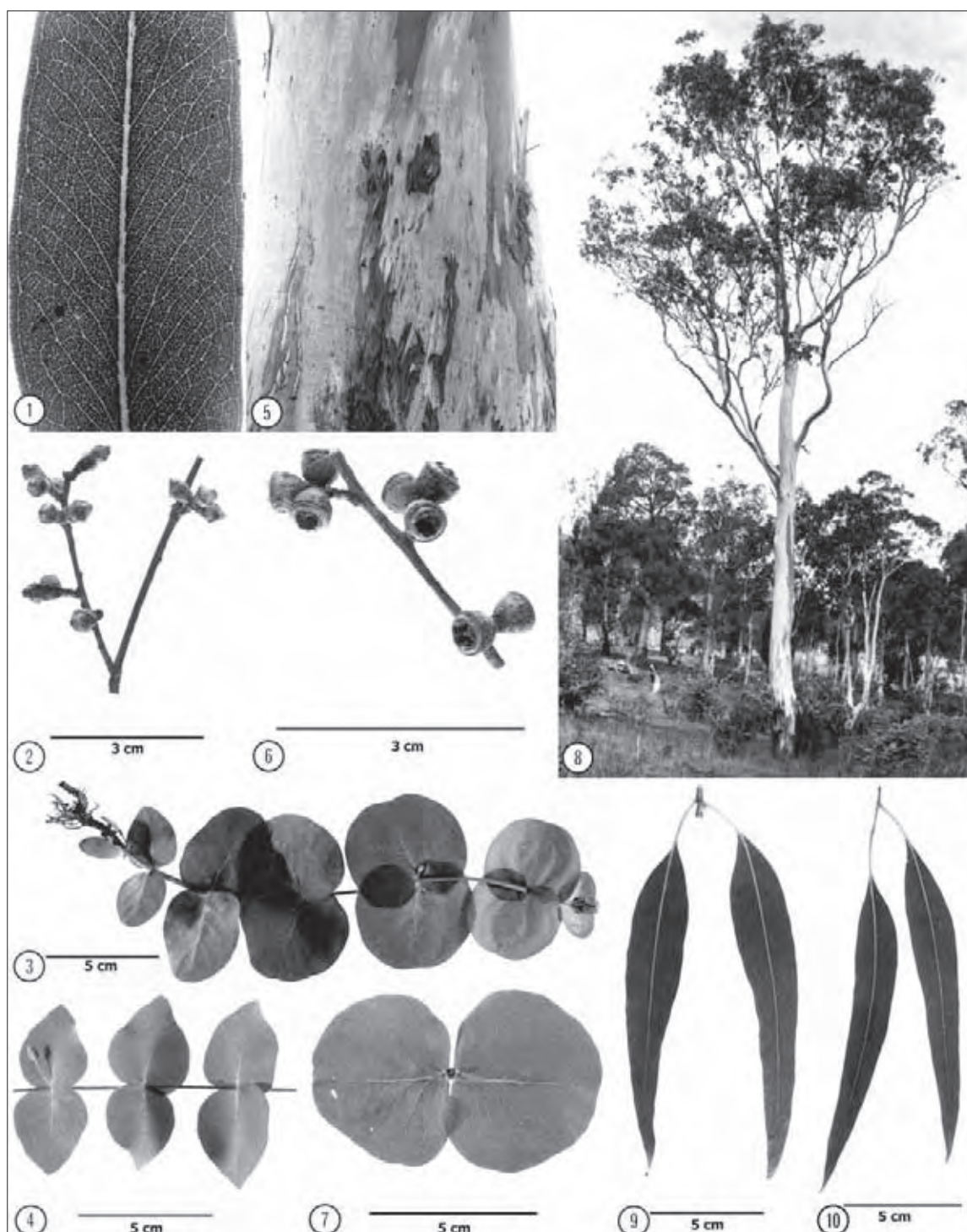
Inflorescences: Simple, axillary, 3-flowered; peduncles slightly angular to flattened, 0.3–0.8 cm long; pedicels frequently absent or up to 0.3 cm long; buds double-conic or more or less ovoid, 0.5–0.7 × 0.3–0.4 cm; opercula usually conical. Branchlets and inflorescences often pruinose. Flowers Jan.–Apr.

Fruits: Sessile or very shortly pedicellate, subglobular or more or less hemispherical, 0.4–0.6 × 0.5–0.7 cm; disc usually broad, more or less level or ascending; valves 3 or 4, slightly to distinctly exserted; fruits occasionally pruinose. Seeds flattened-ellipsoidal, black, hilum ventral.

Wood: Tough, moderately hard and strong, not durable, generally regarded as a second-class building timber; density 550–735 kg m⁻³, used occasionally for fencing and Prewood. Wood is very similar to manna gum (*E. viminalis*).

Climate: Altitudinal range: 75–1600 m (*rubida*), 1000–1100 m (*barbigerorum*); Hottest/coldest months: 19–28°C/–4–5°C (*rubida*), 26–27°C/0–1°C (*barbigerorum*); Frost incidence: high, common throughout the ranges of both taxa with 15–100 or more each year; snowfalls at high elevations. Rainfall: 550–1400 mm per year, winter max. to uniform (*rubida*), 800–900 mm per year, summer max. (*barbigerorum*).

Distinctive features: A medium-sized, smooth-barked woodland or open forest tree of relatively high altitude sites; juvenile leaves sessile, amplexicaul, broader than long, pruinose, greyish blue; inflorescences 3-flowered.



Eucalyptus rubida subsp. *rubida* 1. Adult leaf venation 2. Buds 3. Seedling 4, 7. Juvenile leaves 5. Bark 6. Fruits 8. Tree, near Westerway, Tas. 9. Intermediate leaves 10. Adult leaves

Tingaringy Gum

Eucalyptus glaucescens Maiden & Blakely

Tingaringy gum is markedly variable in habit. It is commonly a mallee or small bushy tree up to 10 m tall on harsh, stony sites but on optimal sites it attains 50 m in height and 1 m dbh, for example, near Mt Erica on the Baw Baw Plateau, about 120 km east of Melbourne.

Tingaringy gum grows in a number of small, scattered localities within a limited area in the subalpine and high mountain country of the Great Dividing Range in eastern Victoria (Mt Tingaringy, Brumby Point, Mt Hotham, Baw Baw Plateau, Mt Erica) and south-eastern New South Wales (Jindabyne, Guthega). Tingaringy gum occurs in areas where heavy snowfalls during winter are common. Small populations of the mallee form of Tingaringy gum occur in the Tidbinbilla and Tinderry Ranges south-west and south-east of Canberra.

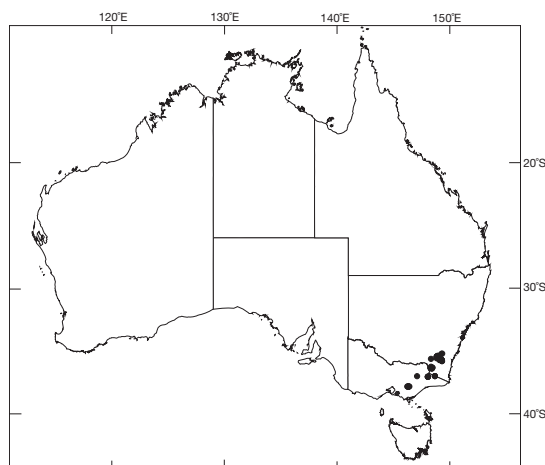
On the steeper and rockier sites where this species grows, the soils are skeletal but on more moderate topography there may be transitional tenosols (alpine humus) and some moor peats. At Mt Erica the deep soils have developed among granodiorite boulders on steep slopes. On Mt Tingaringy the species grows on Ordovician slates and in the Tinderry Ranges it occurs among massive granite outcrops.

Tingaringy gum occurs in open forests, woodlands or tall shrublands. Associated species include snow gum (*E. pauciflora*), mountain gum (*E. dalrympleana*), alpine ash (*E. delegatensis*), spinning gum (*E. perriniana*) and silver wattle (*Acacia dealbata*). In the Victorian commercial forests at Mt Erica it grows with alpine ash, mountain ash (*E. regnans*), shining gum (*E. nitens*) and myrtle beech (*Nothofagus cunninghamii*).

Related species: Brooker (2000) placed Tingaringy gum in series *Orbicularis* with nine other species, all 3-flowered, five of which are endemic to Tasmania. The related eucalypts are nearly all species of high montane or subalpine habitats. The exception is spinning gum (*E. perriniana*), which can occur at low altitudes in Tasmania, although it is a montane species on the mainland. It is distinguished by the connate juvenile leaves, which are often seen in the mature plant. The tree form of Tingaringy gum has rough fibrous bark on the lower trunk and is easily distinguished from Bogong gum (*E. chapmaniana*), another mountain species of far south-eastern New South Wales and eastern Victoria, which has rough bark over most of the trunk and has larger juvenile and adult leaves. The mallee form may be confused with the more restricted Suggan Buggan mallee (*E. saxatilis*), from Little River Gorge in far eastern Victoria and adjacent areas of far south-eastern New South Wales, which has larger buds with very strongly beaked opercula and campanulate fruits. The orbicular juvenile leaves and larger, sessile, cylindrical fruits easily distinguish it from manna gum (*E. viminalis*).

Publication: *Crit. Revis. Eucalyptus* 8, 56 (1929). Type: Tingaringy Mountain, Victoria, 20 Jun. 1887, W. Baeuerlen.

Names: Botanical Latin *glaucescens* (glaucescent), of the branchlets, buds, fruit and juvenile leaves. Common refers to the mountain where the type specimen was collected.



Bark: Smooth on small trees and mallees at high altitudes, the bark decorticating in strips to leave an orange, grey or whitish surface; on larger trees subfibrous, persistent on the lower part of the trunk and shed above in long narrow ribbons; the freshly exposed bark usually has rather colourful shades of green.

Leaves: Seedling Opposite, sessile, amplexicaul, more or less orbicular, usually broader than long, 1.4–3 × 1.4–4 cm, greyish blue, pruinose, concolorous. Juvenile Opposite, sessile, amplexicaul, more or less orbicular, usually broader than long, emarginate, 3–7 × 4–8 cm, greyish blue, pruinose, concolorous. Intermediate Alternate, petiolate, ovate to broad-lanceolate, 9–17 × 2.5–5 cm, greyish blue at first, becoming green, concolorous. Adult Alternate, petiolate, broad-lanceolate to lanceolate, 7–12 × 1.3–2.5 cm, green, concolorous.

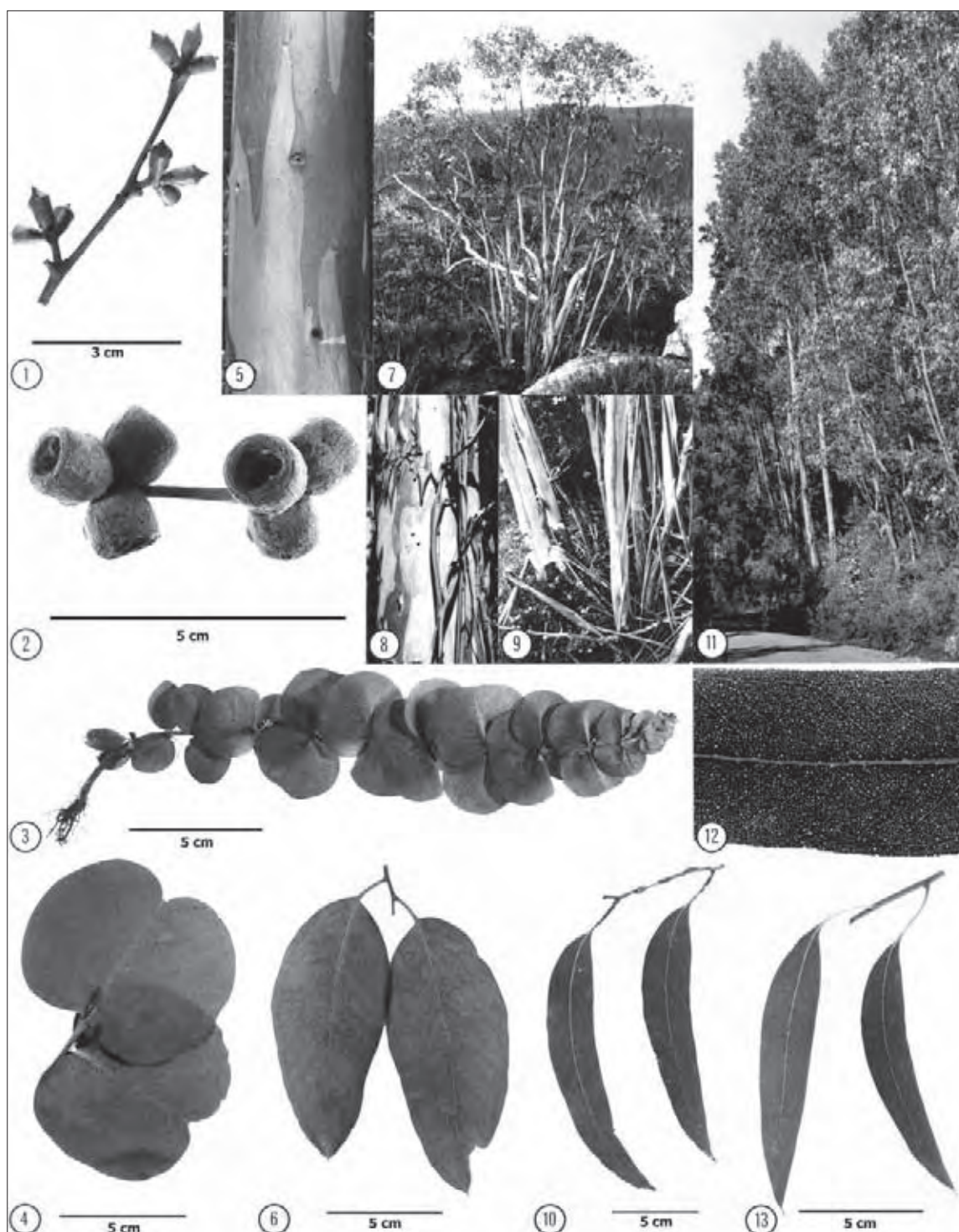
Inflorescences: Simple, axillary, 3-flowered; peduncles stout, more or less terete, 0.2–0.6 cm long; pedicels absent, or up to 0.2 cm long for central bud; buds more or less cylindrical, 0.7–1 × 0.4–0.5 cm; opercula hemispherical-apiculate or rostrate. Flowers Mar.–Apr.

Fruits: Sessile, or sometimes with a very short pedicel on central fruit, more or less cylindrical to truncate-ovoid, 0.6–1.2 × 0.6–1 cm; disc relatively broad, more or less level to descending; valves 3(4), short, broad, more or less horizontal, about rim level or slightly enclosed. White wax may not be obvious with freshly picked fruits but becomes distinct on drying.

Wood: Heartwood darker in colour than that of the associated (unrelated) ash species in Victoria; tends to be woolly off the saw; very little available in commercial size.

Climate: Altitudinal range: 825–1650 m; Hottest/coldest months: 17–26°C/–4–1°C; Frost incidence: high (frequent, severe with 100–200 each year and heavy snow falls during winter); Rainfall: 650–1800 mm per year, uniform.

Distinctive features: A straggly, smooth-barked mallee or tall tree with thin, subfibrous, persistent rough bark on lower trunk, decorticating in ribbons above; juvenile leaves sessile, rounded; peduncles short; buds sessile in 3s; fruits usually cylindrical, sessile; branchlets, buds, fruits and juvenile leaves greyish blue.



Eucalyptus glaucescens 1. Buds 2. Fruits 3. Seedling 4. Early juvenile leaves 5, 8, 9. Bark 6. Later juvenile leaves 7. Mallees, Tinderry Ranges, east of Michelago, N.S.W. 10. Intermediate leaves 11. Trees, Mt Erica, Vic. 12. Adult leaf venation 13. Adult leaves

Cider Gum and Alpine Cider Gum

Eucalyptus gunnii Hook. f. and *Eucalyptus archeri* Maiden & Blakely

Cider gum and alpine cider gum are two closely related species—the former a tree up to 25 m tall and dbh to 1 m (*E. gunnii*), and the latter a small straggly tree or mallee 3–10 m tall (*E. archeri*). Both are generally of poor form and frequently branch near ground level.

The cider gums are endemic to Tasmania. Cider gum (*E. gunnii*) occurs mainly on the plains and low hills of the central highlands with a few other relatively high altitude occurrences. There is an isolated occurrence south of Hobart at Snug Plains. Alpine cider gum (*E. archeri*) occurs at the higher altitudes of the central plateau, particularly the watershed north of the Great Lake, and in a few other elevated regions notably the Cradle Mountain and Ben Lomond areas to altitudes of 1400 m. Cider gums are adapted to some of the coldest conditions experienced by any eucalypt.

The cider gums grow on plateaux and mountain sides and tops often where the drainage is poor. The soils are peaty and weakly developed with large rocks covering much of the ground surface.

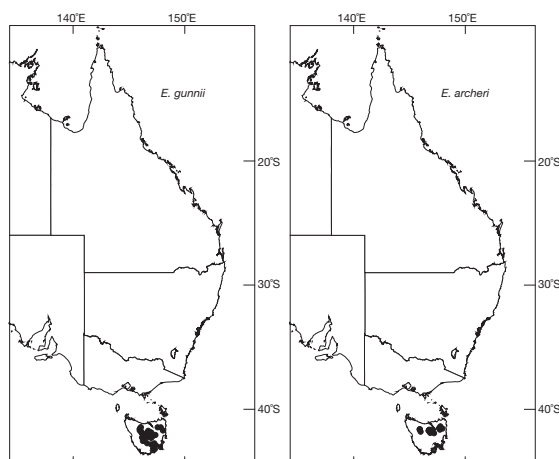
These trees grow in woodlands or low woodlands. Alpine cider gum is often found among alpine grasses and shrubs in scattered clumps interspersed with marshy areas and rocky outcrops. The only other eucalypt in these areas is the unrelated Tasmanian snow gum (*E. coccifera*). Cider gum, at its lower elevations, may be found in open pure stands or in association with *E. coccifera*, blue leaf (*E. delegatensis*), swamp peppermint (*E. rodwayi*) and mountain gum (*E. dalrympleana*).

Related species: Brooker (2000) placed the cider gums in series *Orbiculares* with eight other species, all 3-flowered species of high montane or subalpine habitats. The exception is spinning gum (*E. perriniana*), which can occur at low altitudes in Tasmania. It is distinguished by the connate juvenile leaves, which are often seen in the mature plant. The orbicular juvenile leaves of the cider gums easily distinguish them from manna gum (*E. viminalis*). Of the other Tasmanian endemic species in the series, the cider gums are placed near to Morrisby's gum (*E. morrisbyi*), which has a very restricted distribution east of Hobart. It has a pendulous canopy, longer peduncles and thinner, bluish green leaves. Urn gum (*E. urnigera*) is another mountain gum, which has larger, urceolate fruits.

Publication: *E. gunnii*: London J. Bot. 3, 499 (1844). Type: ♂ on the elevated tablelands of the interior of Tasmania, especially in the neighbourhood of the lakes, R.C. Gunn 1080, 1082 & 1084. *E. archeri*: Crit. Revis. *Eucalyptus* 8, 58 (1929). Type: ♂ Western Mountains, Tasmania, Jan. 1848, W.H. Archer.

Names: Botanical—after the collectors of the type specimens. Common—it is believed that the Tasmanian Aboriginal people used to tap the trees for the sap, which they allowed to ferment before drinking.

Bark: Decortivating in strips from the trunk and branches but on large specimens occasionally persisting for a metre or so at the base. The freshly exposed surface is smooth, mainly white to light grey but sometimes with pink and greenish patches.



Leaves: Seedling—opposite, sessile, orbicular, 1.6–3.5 × 0.8–2.5 cm, greyish green, slightly discoloured or concolorous. Juvenile—opposite and sessile, later becoming alternate and shortly petiolate, ovate to orbicular, 3–7 × 2–5 cm, pruinose (*gunnii*) or non-pruinose (*archeri*), concolorous. Intermediate—alternate, petiolate, ovate, 7–11 × 2.5–4.5 cm, greyish green or green, concolorous, somewhat thick or leathery. Adult—alternate, petiolate, elliptical, ovate or broad-lanceolate, 5–8.5 × 1.1–2.9 cm, greyish green (*gunnii*) or green (*archeri*), concolorous, fairly thick.

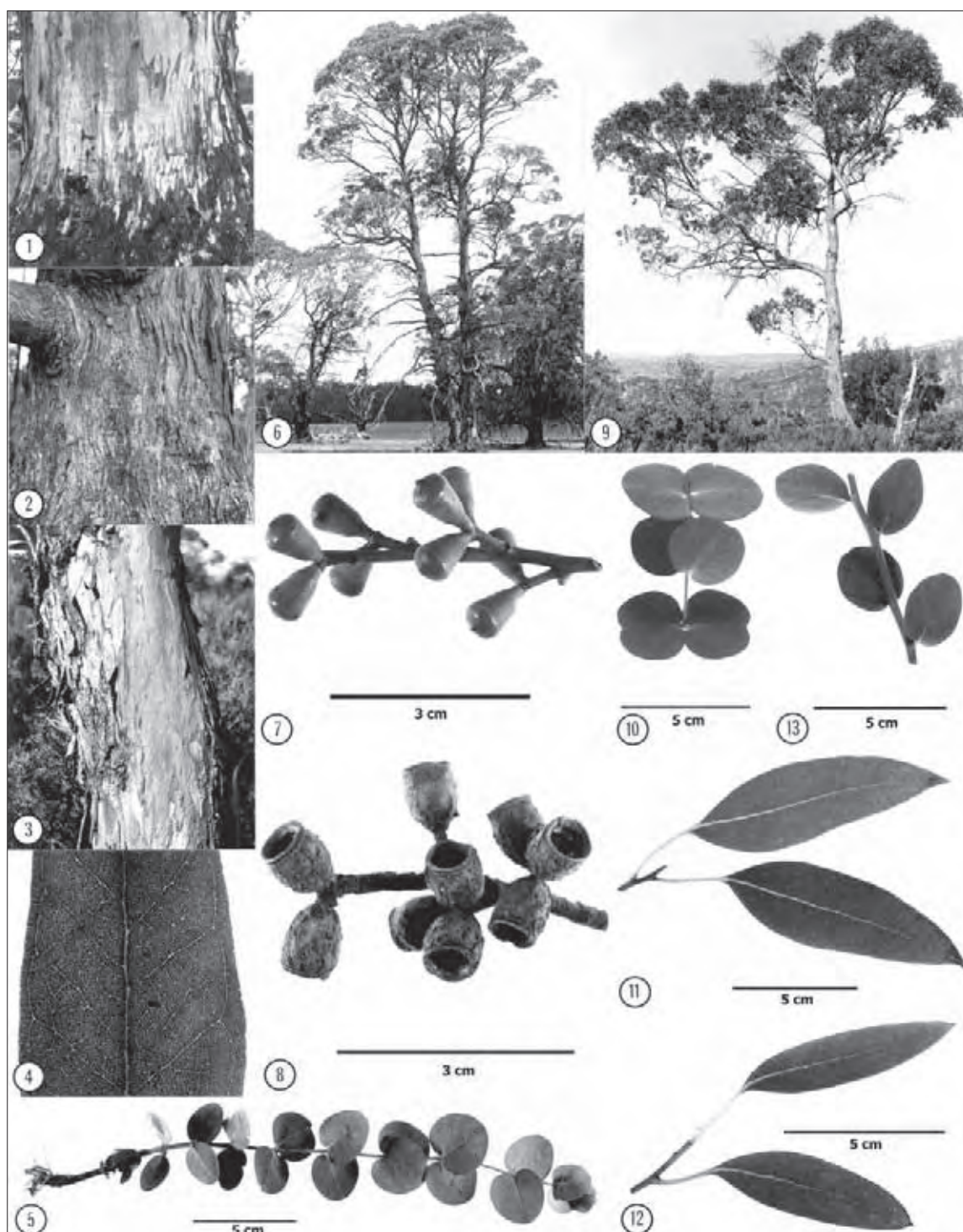
Inflorescences: Simple, axillary, 3-flowered; peduncles slightly angular to more or less flattened, 0.2–0.9 cm long; pedicels absent or occasionally to 0.2 cm long; buds 0.4–0.8 × 0.3–0.4 cm, sometimes pruinose (*gunnii*) or non-pruinose (*archeri*), hypanthia obconical; opercula hemispherical, hemispherical-apiculate or flattened and with a slight beak. Flowers Jan.–Feb.

Fruits: Sessile or shortly pedicellate, truncate-ovoid to slightly urceolate or more or less hemispherical, 0.5–0.9 × 0.4–0.8 cm, sometimes pruinose (*gunnii*) or non-pruinose (*archeri*); disc relatively broad, level to slightly ascending or slightly descending; valves 3 or 4, short, enclosed or to rim level, with a covering skin (pellicle).

Wood: Poorly known.

Climate: Altitudinal range: 600–1400 m; Hottest/coldest months: 12–18°C/–2–0°C; Frost incidence: high (severe and numerous with up to 150 or more each year); snow falls over much of the range. Rainfall: 750–2800 mm per year, uniform to winter max.

Distinctive features: Small to medium-sized trees of alpine and subalpine areas of Tasmania; juvenile leaves ovate to orbicular; buds and fruits in 3s, sessile or nearly so, and with short peduncles. Juvenile leaves are used in the cut foliage trade locally and overseas.



Cider gums: *Eucalyptus archeri* (a), *E. gunnii* (g) 1, 2. Bark (g) 3. Bark (a) 4. Adult leaf venation (g) 5. Seedling (g) 6. Trees (g), Jacks Marsh, Central Plateau, Tas. 7. Buds (g) 8. Fruits (g) 9. Tree (a), near Pine Lake, Central Plateau, Tas. 10. Early juvenile leaves (g) 11. Intermediate leaves (a) 12. Adult leaves (a) 13. Later juvenile leaves (a)

■ Boxes and Ironbarks

Eucalyptus section *Adnataria* L.D. Pryor & L.A.S. Johnson ex Brooker

There are about 100 species of boxes and ironbarks making them the second largest group in subgenus *Symphyomyrtus* after section *Bisectae*. Species of the group are widely distributed over mainland Australia. There are none in the higher rainfall, far south-west of the continent or Tasmania. Records from islands to the north are sparse, but one species (*E. leptophleba*) occurs on neighbouring Thursday Island and in Western Province, Papua New Guinea.

The name 'box' was applied by the early settlers who saw a resemblance between the hard, interlocked timber of the European box (*Buxus sempervirens* L.) and that of grey box (*Eucalyptus moluccana*). The name 'ironbark' describes the easily recognised, hard, deeply fissured, kino-impregnated bark of many of the species of *Adnataria*. The term 'box' is further applied to describe the bark characteristic of many species of *Adnataria*, that is, finely fibrous, usually grey and held in small tessellations which, on being lost through weathering, expose whitish patches. This type of bark occurs in a few species of other groups such as white-topped box (*E. quadrangulata*) and apple box (*E. bridgesiana*).

The timber of the boxes and ironbarks is among the most valuable hardwood in Australia. It is hard, strong and durable. The heartwood is usually coloured, varying from pale brown to yellow and dark red. The wood is used for heavy

engineering construction, poles, railway sleepers and fencing.

Commercially important species include the grey boxes (*E. moluccana* and *E. bosistoana*), the ironbarks (*E. fibrosa*, *E. crebra* and *E. sideroxylon*), yellow box (*E. melliodora*), which is Australia's most important honey producer, and blue-leaved mallee (*E. polybractea*), an important producer of eucalypt oil.

Botany

The boxes and ironbarks are distinguished in having reniform cotyledons and adnate anthers. The inflorescences are usually terminal although they are axillary in the small series *Melliodorae*.

The primary division of the section is based on the disposition of the anther as seen in flower. In subsection *Apicales*, the anther is erect on the filament of the stamens, while in subsection *Terminales*, the anther is deflected laterally at the tip of the filament. Classification below this level is complex and is based on the early or late dehiscence of the outer operculum, the inflexion of the staminal filaments, and the nature of the bark whether 'box' or 'ironbark'. The subsections include both box-barked species and iron-barked species. *Adnataria* includes a few smooth-barked species.

The ironbarks, which are among the most easily recognised group of eucalypts, fall into two subsections, a large number in *Apicales* and the remainder in *Terminales*. Bud dissection to test for filament inflexion is required to distinguish the two groups.

■ The Boxes

Eucalyptus subsection *Apicales* Brooker

This is a group of about 50 species distributed widely in mainland Australia. A northern group, series *Aquilonares*, occurs from the Pilbara and Kimberley region of Western Australia across the continent to Cape York Peninsula. The southern boxes (series *Buxeales*) include three species only in southern Western Australia (*E. petraea*, *E. absita*, *E. cuprea*), while there is a large gap in distribution taking in the Great Victoria Desert and the Nullarbor Plain. The remainder of the boxes of this group are mainly of south-eastern distribution, although grey box (*E. moluccana*) occurs along the east coast of the continent as far north as the Atherton Tableland.

Most box species are woodland trees. A few, for example, Normanton box (*E. normantonensis*), blue-leaved mallee (*E. polybractea*) and green mallee (*E. viridis*) are mallees of tall shrublands. Two species can grow into large forest trees, namely Queensland western white gum (*E. argophloia*) and coast grey box (*E. bosistoana*). Any box species of good form usually provides high quality, usable timber. No box species is of particular ornamental value although in its natural habitat, popular box (*E. populnea*) is an attractive, bright green, shiny-leaved tree. The rare Gawler Range mallee, *E. lansdowneana* is potentially a fine ornamental shrub with its moderately large red flowers and large, thick, shining green leaves.

Botany

Botanically the boxes are somewhat difficult to categorise into discrete series. The division of the boxes to northern (e.g. *E. microtheca*) and primarily eastern and southern species (e.g. *E. microcarpa*) is rather arbitrary. Most species in both groups are clearly related to others, e.g. *E. patellaris* and *E. oligantha* in the north and *E. microcarpa* and *E. albens* in the south. A few species, however, are difficult to relate to others and are taxonomically isolated, e.g. *E. thozetiana* and *E. ochrophloia* in which the two opercula

appear to be fused, a character not seen elsewhere in the boxes, *E. dawsonii* of subsection *Apicales* which somewhat resembles *E. polyanthemos* of subsection *Terminales*, and *E. rummeryi*, the only box species with discoloured adult leaves, an atavistic character perhaps reflecting its evolution in relatively mesic conditions.

Some of the northern boxes are fairly easily recognised by the prominent broad disc of the fruits (e.g. *E. patellaris*). An exception in this group is *E. tectifera* with its thin-rimmed fruits, which is also notable for its slender branchlets and petioles resulting in a somewhat pendent canopy. Coolibah is perhaps the best-known of the northern box 'species', but has been taxonomically confused in the past. The currently accepted names are *E. microtheca*, the completely rough-barked trees of far northern distribution only, *E. coolabah*, half-barked trees widespread from the River Darling in western New South Wales through central Australia as far as the Fitzroy River of the southern Kimberley of northern Western Australia, and *E. victrix*, completely smooth-barked trees occurring from the Murchison River and north to the Pilbara of Western Australia and eastwards to central Australia.

Some species have both tree and mallee forms, e.g. *E. obconica*, confined to the Kimberley of Western Australia, and *E. pruinosa*, widespread across northern Australia, which is very conspicuous in the field being reproductively mature in the pruinose, juvenile leaf phase.

The southern boxes, series *Buxeales*, divide into two groups, one in which the outer operculum is shed well before flowering (subseries *Amissae*) resulting in a median scar to the bud, and the other in which the outer operculum is held until near flowering (subseries *Continentes*) whereby the buds do not carry a characteristic median scar.

The species of series *Coalitae* (*E. ochrophloia* and *E. thozetiana*) are distinctive in having completely inflexed staminal filaments. *E. bosistoana* and *E. argophloia* are notably very tall trees. Coowarra box (*E. cambageana*) can be recognised by the fruits alone because of the white

pellicle on the inwardly sloping disc of the fruits. Its tessellated 'half-bark' is also distinctive. Other species which are distinctive by single features are bull mallee (*E. behriana*) which has oily green, smooth upper bark, white box (*E. albens*) which has box bark with mottling caused by outer weathered grey bark contrasting with patches of newly exposed white bark, and *E. viridis* which has linear, bright green leaves. Two species are conspicuous for their coloured flowers, the red-flowered *E. lansdowneana* and the white, pink or purple-flowered *E. albopurpurea*, both endemics to South Australia and popular ornamentals.



Smooth-barked coolibah (*Eucalyptus victrix*) shown near Lake Gregory, W.A. often forms pure stands on seasonal floodplains mainly throughout the arid tropical to subtropical interior of Western Australia and Northern Territory.



Lapunyah or western white gum (*E. argophloia*) is restricted to a small area near Chinchilla in south-eastern Queensland. Despite its limited natural occurrence, under cultivation it grows well, has good form and is being used as a dryland forestry species for timber production. 1. A fast-growing, cultivated tree at the Waite Institute, Adelaide, S.A. 2. A seed collector climbing a tree to procure seed from a tree in a natural stand near Burnthclith. 3. A remnant natural stand at Burra Burri, Qld. This species is legislated as rare and vulnerable and all existing stands are under special protection by State and Federal Conservation Acts.

Steel Box Rummery's Box

Eucalyptus rummeryi Maiden

Steel box is a medium-sized to tall tree, usually with a straight trunk up to two-thirds of the tree height and a crown of only moderate size in the typical tall open forest and marginal closed-forest habitat, though larger-crowned in open-growing situations. Maximum height is about 45 m, with dbh up to 1 m.

Steel box is a tree of north-eastern New South Wales, where it grows on the undulating and hilly foothills between the coastal lowlands and the mountains of the escarpment. It occupies a narrow belt about 200 km long from near Coffs Harbour to an area to the north-west of Casino. It is probably most common in parts of the Richmond Range, which extends from north of Grafton to west of Kyogle, and also occurs in the Glenreagh–Moileton–Coramba area north-west of Coffs Harbour.

Steel box grows on the slopes and tops of broad ridges in hilly country or on undulating topography edging the lowlands. The soils are generally fairly fertile, often being derived from basalt, though schists and sandstones occur. The subsoils are clayey, while the surface layers usually contain significant amounts of forest humus.

This is a species of the better quality tall open forests, especially those close to the margin of rainforests in which the dominant trees are hoop pine (*Araucaria cunninghamii*) and crows ash (*Flindersia australis*), while the understorey contains many species of Sapindaceae and Euphorbiaceae. Associated tree species include cabbage gum (*E. amplifolia*), variegata (*E. citriodora* subsp. *variegata*), grey box (*E. moluccana*), grey ironbark (*E. paniculata*), forest red gum (*E. tereticornis*), grey gums (e.g. *E. propinqua*), brush box (*Lophostemon confertus*) and turpentine (*Syncarpia glomulifera*).

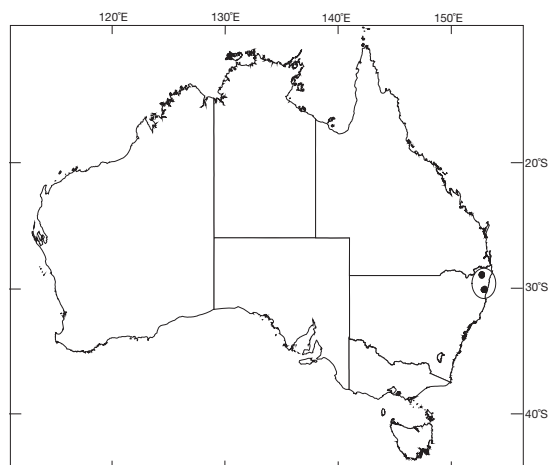
Related species: Brooker (2000) placed steel box in series *Buxaeles*, supraspecies *Contrariae*, i.e. a southern box of subseries *Amissae* and the only species of the group with discolorous adult leaves. It is probably closest to Craven grey box (*E. largeana*), another tall forest tree species which occurs to the south of steel box and differs by the concolorous adult leaves.

Publication: *Crit. Revis. Eucalyptus* 6, 427 (1923). Type: Busby's Flat, near Casino, New South Wales, Oct. 1921, G.E. Rummery.

Names: Botanical—after the collector of the type G.E. Rummery (1877–1958), at that time District Forester at Casino. Common—possibly refers to the steel grey colour of the box-type bark or to the hardness of the wood.

Bark: Box-type, persistent to small branches, flaky, platy; outer weathered bark grey-brown, inner newly exposed bark whitish in patches; inner bark red-brown.

Leaves: Seedling—opposite for 3–5 pairs then alternate, petiolate, ovate, 4–8.5 × 1.5–3 cm, green, discolorous. Juvenile—alternate, petiolate, ovate to broad-lanceolate, 8–12 × 3–4 cm, green, discolorous. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 10–17 × 2.4–3.5 cm,



green, discolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 9–16 × 1–2.3 cm, green, discolorous.

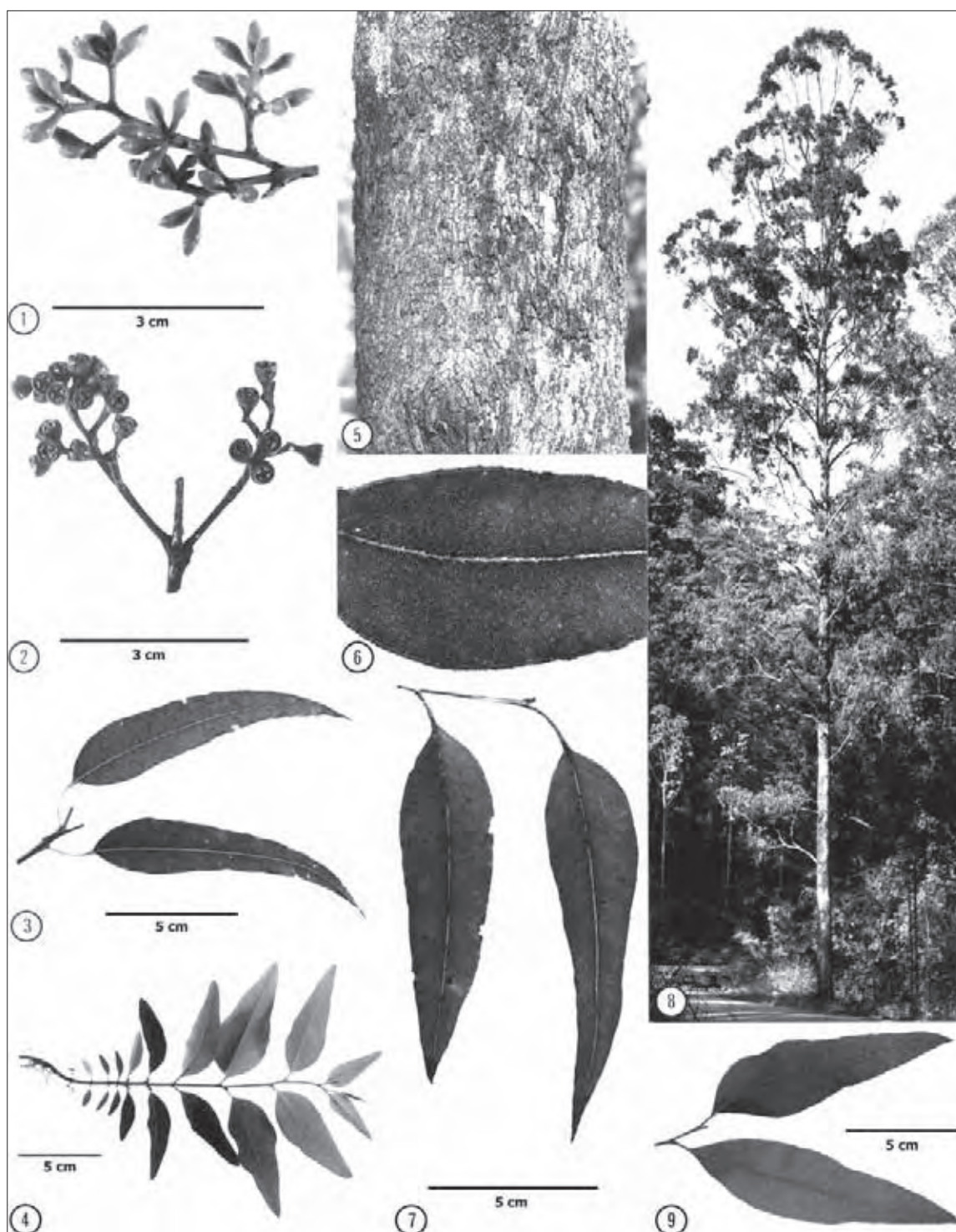
Inflorescences: Axillary and terminal panicles, unit inflorescences 7-flowered; peduncles angular to slightly flattened, 0.3–0.8 cm long; pedicels angular, 0.2–0.3 cm long; buds ovoid or fusiform, 0.5–0.6 × 0.2–0.3 cm, sometimes with ribbed hypanthia; opercula conical. Flowers Dec.–Jan.

Fruits: Pedicellate, obconical, 0.4–0.5 × 0.3–0.4 cm; disc narrow, descending; valves 4, erect, about rim level to slightly exerted. Seeds ovoid or compressed-ovoid, brown, hilum ventral.

Wood: Heartwood yellowish brown when freshly cut but dries to pale brown with grey cast, rather interlocked and coarse-grained, tough, considered to be strong and durable and somewhat like grey ironbark (*E. paniculata*) q.v.; density approximately 1130 kg m⁻³, used for poles, railway sleepers and heavy construction.

Climate: Altitudinal range: 100–500 m; Hottest/coldest months: 26–29°C/2–4°C; Frost incidence: low to moderate (20 or more each year at high elevations); Rainfall: 1100–1500 mm per year, summer max.

Distinctive features: A moderately tall tree with box-type bark; all stages of leaves discolorous, margins slightly undulate; inflorescences of small panicles; small, ovoid or fusiform buds and small fruits with a narrow disc and thin, deltoid valves near rim level.



Eucalyptus rummeryi 1. Buds 2. Fruits 3. Adult leaves 4. Seedling 5. Bark 6. Adult leaf venation 7. Intermediate leaves 8. Tree, Moletton area, north-west of Coffs Harbour, N.S.W. 9. Juvenile leaves

Molloy Red Box

Eucalyptus leptophleba F. Muell.

Molloy red box is usually a medium-sized tree up to 25 m in height with maximum dbh of about 1 m. At its best it has a trunk form suitable for utilisation but as open-growing trees on poor sites it may be only 8–15 m high, with short trunks of only moderate form, and wide, heavily branched crowns which may be as wide as the trees are high.

This species has its main occurrence on the central and eastern parts of Cape York Peninsula and extends southwards to about 250 km south of Cairns inland from Ingham. It grows almost to the tip of the Peninsula. It is common in the Mt Garnet district on the Great Dividing Range, south-west of Cairns. It occurs on Thursday Island and in 1981 it was discovered in the Western Province of Papua New Guinea.

The topography favourable to Molloy red box varies from lowland river valleys to gentle hill slopes and undulating country at higher altitudes. There is a wide range in soil types including sandy alluviums, basaltic brown loams and fine red sands.

This species grows in open forests or woodlands. Associated eucalypts include ghost gums (*E. tessellaris*, *E. aparrerinja* subsp. *dallachiana*, *E. confertiflora*), red gums (*E. platyphylla*, *E. tereticornis*) and Clarkson's bloodwood (*E. clarksoniana*). There are many other associated genera such as *Erythrophleum*, *Lophostemon*, *Melaleuca*, *Casuarina* and *Pandanus*.

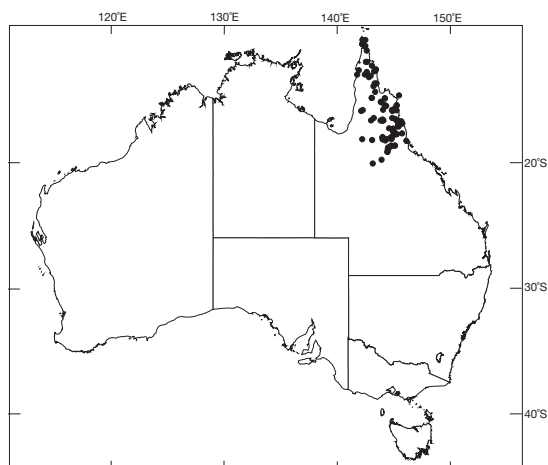
Related species: Molloy red box was placed by Brooker (2000) in series *Aquilonares*, subseries *Fortes*, a group notable among the northern boxes for the relatively large robust fruits compared with the more fragile fruits of species such as Darwin box (*E. tectifica*). Molloy red box differs from the related weeping box (*E. patellaris*) and broad-leaved box (*E. oligantha*) by the more or less inconspicuous, descending disc of the fruits. The trees have bluish green or light green adult leaves which distinguish them from the prominently grey or pruinose-leaved, neotenus silver box (*E. pruinosa*) and Cloncurry box (*E. leucophylla*), which are both species of lower stature and of north-western distribution in Queensland.

Publication: *J. Linn. Soc. Bot.* 3, 86 (1859). Type: Gilbert River, Queensland, 1857, F. von Mueller.

Names: Botanical—Greek *leptos* (slender), *phleps* (vein), in reference to the leaf venation. Common—refers to Mt Molloy (a district in which it commonly occurs), to the wood colour and to the box group of eucalypts.

Bark: Box-type, persistent to the small branches, subbrous, compact, but with a moderately rough surface, finally tessellated. In places the outer layers of some of the plates may decorticate to leave a surface, which is smoother, and grey to brownish grey.

Leaves: Seedling—opposite for 3–5 pairs then alternate, petiolate, ovate, 5–11 × 3–7 cm, greyish green, slightly discolorous. Juvenile—alternate, petiolate, ovate, 11–15.5 × 5–9 cm, greyish green, slightly discolorous.



Intermediate—alternate, petiolate, broad-lanceolate to narrow-lanceolate, 16–32 × 3–4.5 cm, bluish or greyish green, concolorous. Adult—alternate, petiolate, broad-lanceolate to narrow-lanceolate, 11–24 × 1.2–3 cm, bluish green or light green, concolorous.

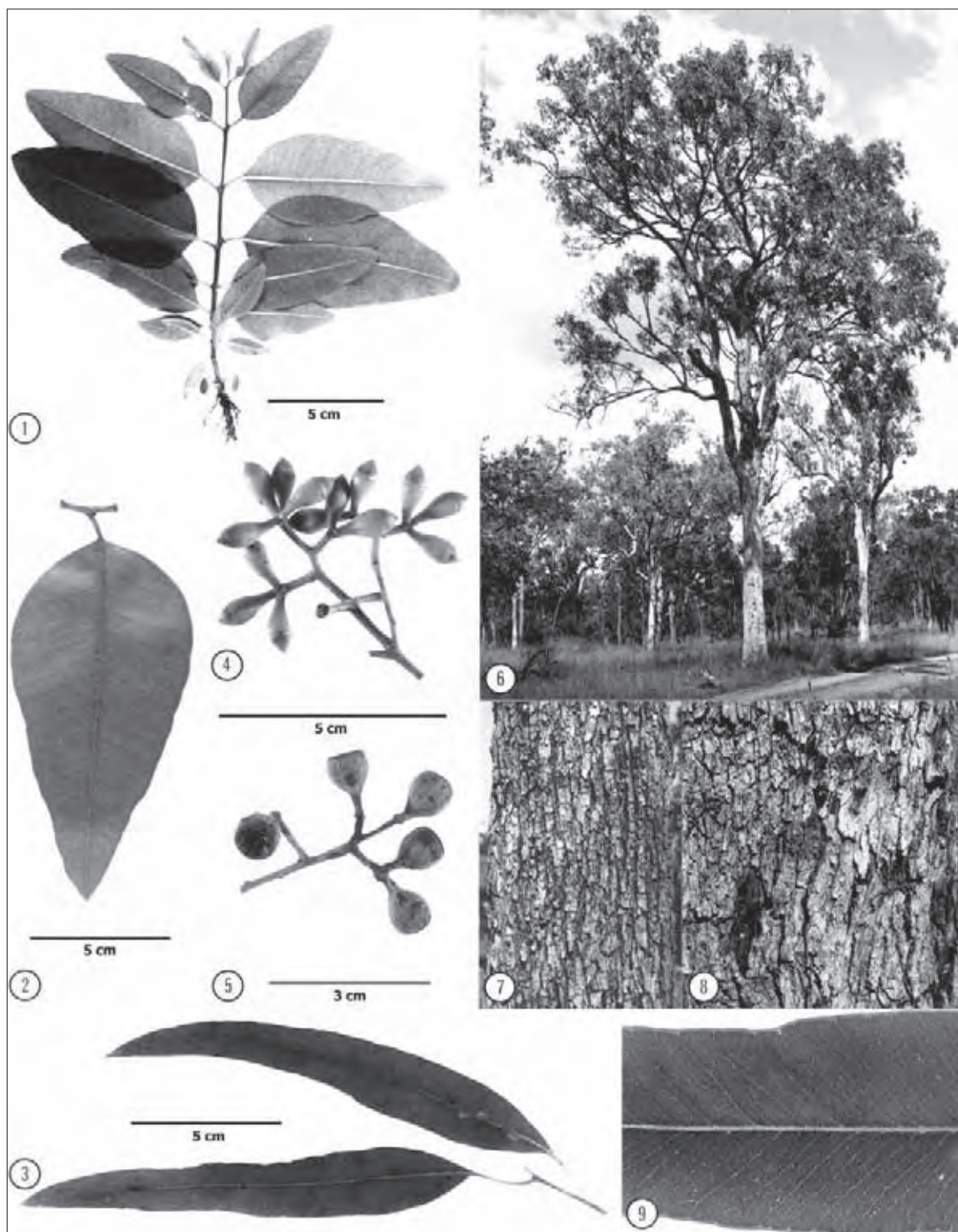
Inflorescences: Axillary and terminal panicles, unit inflorescences 7 to 11-flowered; peduncles terete to slightly flattened, 0.4–2 cm long; pedicels 0.2–0.8 cm long; buds clavate to ovoid, 0.7–1.2 × 0.4–0.6 cm; opercula hemispherical, sometimes apiculate or conical. Flowers Mar.–Aug.

Fruits: Pedicellate, cupular to truncate-ovoid, 0.6–1.1 × 0.5–1 cm; disc, steeply descending; valves 4, erect, enclosed or to rim level or very slightly exserted. Seeds ovoid, sometimes pointed at one end, grey, black or brown, hilum ventral.

Wood: Heartwood reddish brown, hard, very durable; density about 1120 kg m⁻³; used for heavy construction, posts and railway sleepers.

Climate: Altitudinal range: near sea level to 760 m; Hottest/coldest months: 29–35°C/9–22°C; Frost incidence: low; Rainfall: 520–2200 mm per year, summer max.

Distinctive features: A medium-sized, box-barked tree of northern Queensland; adult leaves relatively large; inflorescences terminal or axillary panicles; buds and fruits moderately large for a box; disc descending steeply.



Eucalyptus leptophleba 1. Seedling 2. Juvenile leaf 3. Adult leaves 4. Buds 5. Fruits 6. Tree, Springmount Holding, Qld 7, 8. Bark 9. Adult leaf venation

Darwin Box Grey Box

Eucalyptus tectifica F. Muell.

Darwin box grows commonly to 10 m in height, but in favourable locations may attain 15 m. The trunk is only moderately straight and, like many boxes, divides at comparatively low heights into large, ascending stems and branches, which form a moderately wide and fairly dense crown. The species is often deciduous during the dry season.

Darwin box occurs across the north of the continent, extending from Broome in northern Western Australia to east of Normanton in Queensland. It is found throughout most of the Kimberley region of Western Australia but is absent or rare in the valleys of the Fitzroy River and the upper reaches of the Ord River. In the Northern Territory it is fairly common from Darwin to Mataranka, and occurs on some islands in the Gulf of Carpentaria.

This species occurs over a wide topographical and soil range, from black soil flats to skeletal soils on steep sandstone ridges and soils derived from limestones, andesites and basalts.

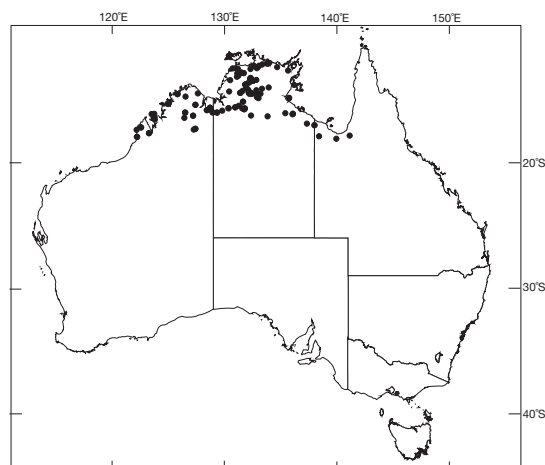
Darwin box typically grows in woodlands, associated with Darwin stringybark (*E. tetradonta*), weeping box (*E. patellaris*), apple gum (*E. clavigera*), broad-leaved carbeen (*E. confertiflora*), white gum (*E. alba*), round-leaved bloodwood (*E. latifolia*) or Darwin woollybutt (*E. miniata*). Other associated genera include *Melaleuca*, *Tristania*, *Acacia* and *Cycas*.

Related species: Brooker (2000) placed Darwin box in the northern series *Aquilonares*, subseries *Protrusae*. This series contrasts with subseries *Fortes* by the smaller, more fragile fruits. It is probably closest to the coolibahs, which differ by the smaller fruits and more conspicuous valves. It differs from the other box species of north-western Queensland, viz. Cloncurry box (*E. leucophylla*), which occurs further south and has more robust obconical fruits and conspicuously bluish green to grey-green adult leaves, and Gilbert River box (*E. microneura*), also of more southern distribution which differs by the very bluish adult leaves. Two other box species of northern Queensland, *E. normantonensis* and *E. chlorophylla*, have glossy green adult leaves. Darwin box can usually be distinguished from all other box species by the pendulous crown of thin bluish or grey adult leaves but can be very difficult to distinguish from the northern coolibah (*E. microtheca*) in the Gulf of Carpentaria region. The fruits of Darwin box are usually larger and very thin-walled somewhat like those of the quite unrelated ghost gums (e.g. *E. aparrerinja*).

Publication: *J. Proc. Linn. Soc. Bot.* 3, 92 (1859). Type: McArthur River, Northern Territory, 5 Aug. 1856, F. von Mueller.

Names: Botanical Latin *tectum* (roof), *facere* (to make), probably in reference to the bark being used by Aboriginal people for shelter. Common refers to its abundance around Darwin and to the bark type.

Bark: Box type, persistent to the small branches, compact, subpeltate, ashy grey, somewhat scaly or tessellated, with the



longitudinal fissures deeper and more regular than the horizontal fissures.

Leaves: Seedling: opposite for a few pairs then alternate, petiolate, lanceolate to broadly ovate, 4.5 × 1.5 cm, usually greyish green, slightly discolorous. Juvenile: alternate, petiolate, lanceolate to ovate, 10 × 1.5 cm, usually greyish green, concolorous. Intermediate: alternate, petiolate, broad-lanceolate, 12 × 2.5 cm, greyish green, concolorous. Adult: alternate, petiolate, lanceolate to narrow-lanceolate, 9 × 1.5 cm, green or greyish green, concolorous. The trees are partly or almost wholly deciduous during the dry season.

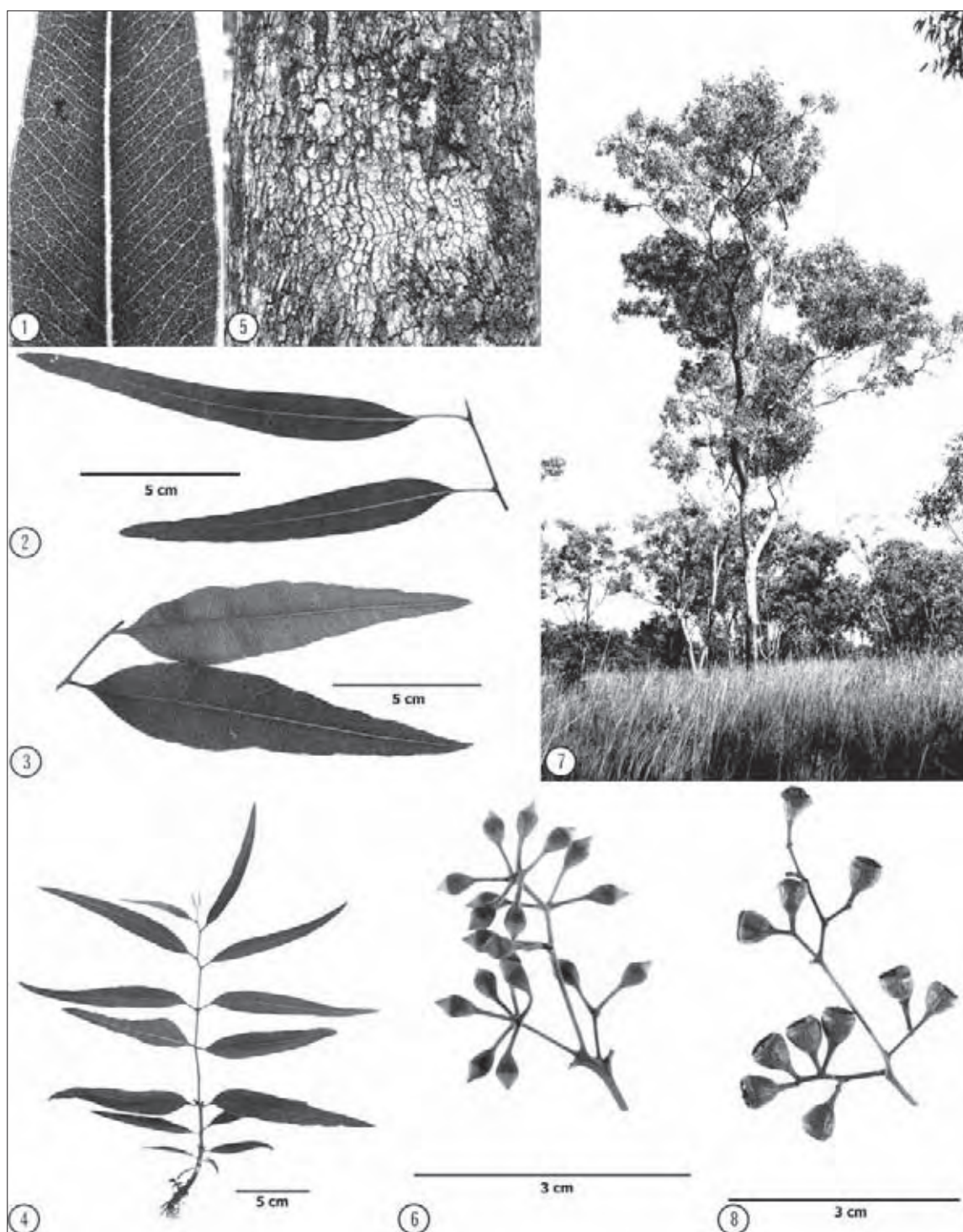
Inflorescences: Terminal panicles, unit inflorescences 7-flowered; peduncles more or less terete, slender, 0.5–1.3 cm long; pedicels slender, 0.1–0.9 cm long; buds pyriform to ovoid, 0.4 × 0.6 × 0.2 cm; opercula rostrate. Flowers Sept.–Nov.

Fruits: Pedicellate, truncate-ovoid to cupular, thin-walled, 0.4 × 0.7 × 0.4 cm; disc broad, steeply descending, almost obscured by the 3 or 4 valves which vary from slightly enclosed to slightly exserted. Seeds ovoid, sometimes pointed at one end, grey, black or brown, hilum ventral.

Wood: Heartwood reddish brown; density about 850 kg m⁻³. The timber is considered of good quality but trees are frequently attacked by termites.

Climate: Altitudinal range: near sea level to 570 m; Hottest/coldest months: 32–39°C/9–20°C; Frost incidence: low; Rainfall: 500–1500 mm per year, summer max.

Distinctive features: Small tree with box bark; branchlets slender, pendent; canopy tending to be bunched and dense; small terminal or subterminal panicles, 7-flowered; very thin-walled fruits.



Eucalyptus tectifica 1. Adult leaf venation 2. Adult leaves 3. Juvenile leaves 4. Seedling 5. Bark 6. Buds 7. Tree, south-east of Katherine, N.T. 8. Fruits

Coolibah Coolabah, Western Coolibah, Smooth-barked Coolibah

Eucalyptus microtheca F. Muell., *E. coolabah* Blakely and Jacobs, *E. victrix* L.A.S. Johnson & K.D. Hill

The coolibahs have a wide geographical range and an associated variation in size from a medium-sized tree 15–20 m in height, with a moderately well-formed bole one-quarter to one-third of the height and up to 1 m dbh, to a poorly formed, small tree with an open, straggly crown and a very short trunk.

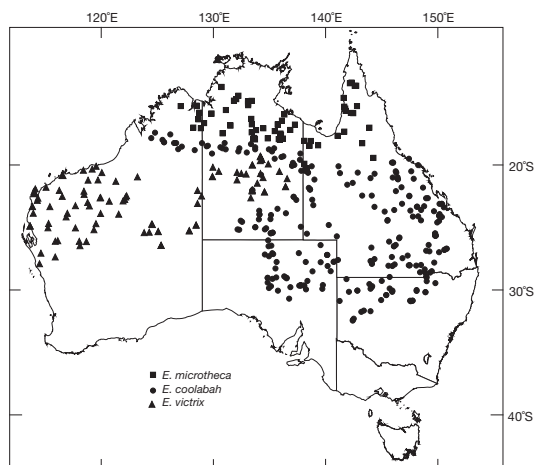
There are three forms: *E. microtheca* which occurs from the lower reaches of the Ord river in the Kimberley region of Western Australia, east across the Northern Territory to northern Queensland and Cape York Peninsula; *E. coolabah* which occurs from the Fitzroy River of the southern Kimberley eastwards through central Australia and north-east South Australia almost to the east coast near Rockhampton and south as far as Menindie in the Darling River in New South Wales; and *E. victrix* which occurs from the Murchison River and Pilbara of Western Australia east to near Tea Tree Well and Tennant Creek of central Northern Territory.

Coolibahs grow on seasonally inundated country around the edges of swamps and lagoons, or occur in open belts along watercourses where soil conditions are favourable. Soils show a wide variation but all have alluvial origins. *E. microtheca* and *E. coolabah* are found on heavy, cracking soils of flood plains, while *E. victrix* can occur on heavy flood plain soils and on red loam or clay loam sands.

Coolibahs are usually woodland or low woodland species. They either form pure stands or may be associated with other eucalypts, including river red gum (*E. camaldulensis*), black box (*E. largiflorens*), bumble box (*E. populnea*), yapunyah (*E. ochrophloia*), numerous species of bloodwood and ghost gums (e.g. *E. aparrentin*, *E. tessellaris*).

Related species: Brooker (2000) placed the coolibahs in series *Aquilonares*, subseries *Protrusae*, which are characterised by their small, thin-walled fruits. Hill and Johnson (1994) described a number of new species in this group, which have been treated here as synonyms. In the south-eastern part of its range, *E. coolabah* has some overlap with black box (*E. largiflorens*). It has rough bark to the smaller branches, narrower juvenile and adult leaves and fruit with enclosed valves. In the north-eastern extent of its range, particularly along the Fitzroy River at Rockhampton, *E. coolabah* may also be confused with the unrelated black ironbox (*E. raveretiana*). It differs in having pinnate and more deeply furrowed bark, strongly discoloured leaves, longer opercula and exceptionally small fruits.

Publication: *E. microtheca*: J. Proc. Linn. Soc. Bot. 3, 87 (1859). Type: Victoria River, N.T., Dec. 1855, F. von Mueller. *E. coolabah* Blakely & Jacobs: *Key Eucalypts* 245 (1934). Type: several specimens from New South Wales, Queensland, Northern Territory, South Australia and Western Australia [see Hill and Johnson (1994) *loc. cit.* for clarification]. *E. victrix*: *Telopea* 5, 765 (1994). Type: 16.3 km N of Tea Tree Well roadhouse on Stuart Highway, 12 Jul. 1984, K. Hill 870, L. Johnson & D. Benson.



Names: Botanical Greek *micro* (small), *theca* (box), refers to small fruits. Common and for *E. coolabah* of Aboriginal origin; Latin *victrix* (feminine of victor, victory), apparently in reference to its success in a very harsh climate.

Bark: *E. microtheca*: box-type bark persistent on the trunk and to the smaller branches; *E. coolabah*: similar rough bark over lower trunk only and smooth on upper trunk and branches; *E. victrix*: smooth, white over whole tree, often powdery.

Leaves: Seedling opposite for 3–6 pairs then alternate, petiolate, ovate to lanceolate, 5–12 × 1–3.5 cm, green to greyish green, slightly discolorous. Juvenile alternate, petiolate, ovate to lanceolate, 7–15 × 2–4 cm, green to greyish green, becoming concolorous. Adult alternate, petiolate, lanceolate to narrow-lanceolate, 8–17 × 0.8–2.5 cm, green to greyish green, concolorous.

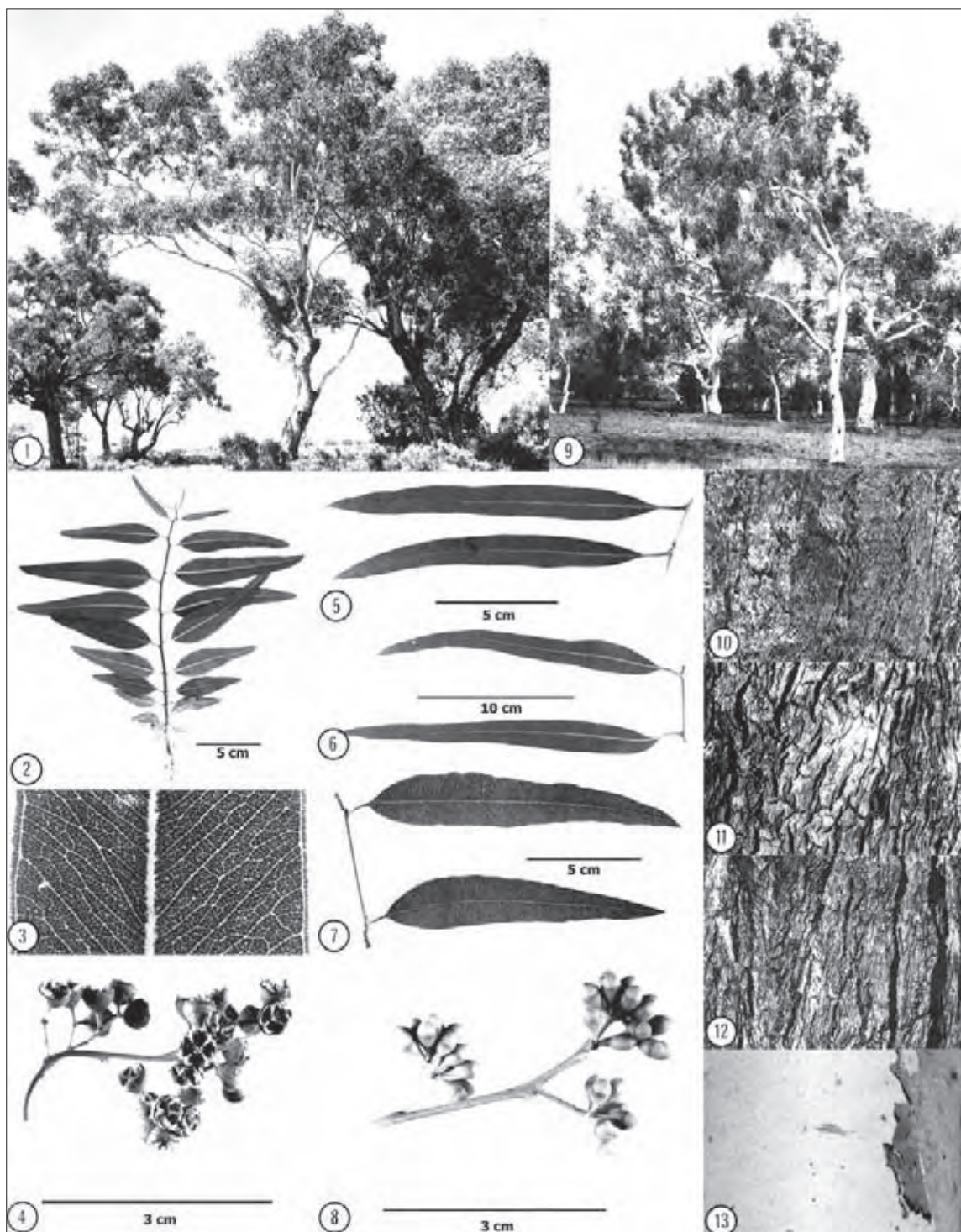
Inflorescences: Terminal panicles, unit inflorescences 7–flowered; peduncles more or less terete, 0.3–0.9 cm long; pedicels 0.1–0.4 cm long or sometimes absent; buds ovoid, 0.3–0.5 × 0.2–0.3 cm; opercula hemispherical, usually apiculate, or conical. Flowers Dec.–Feb.

Fruits: Pedicellate or sometimes sessile, hemispherical or more rarely obconical, 0.1–0.5 × 0.3–0.7 cm; disc very narrow, obscure; valves 3 or 4, broad, erect, prominently exerted in *E. coolabah*, less so in the other species, but variable. Seeds ovoid and slightly angular to compressed-ovoid, brown to reddish brown to yellow-brown, lustrous, hilum ventral. Mature Jan.–Apr.

Wood: Sapwood whitish and narrow; heartwood pinkish brown to reddish brown sometimes with a few dark patches near the centre, and dark brown to almost black with numerous white deposits (not observed in reddish brown specimens), grain interlocked, texture pinnate to very pinnate; density 980–1190 kg m⁻³; used for firewood and fencing.

Climate: Altitudinal range: near sea level to 700 m; Hottest/coldest months: 31–38°C/3–17°C; Frost incidence: low to moderate (may be up to 20 or more each year); Rainfall: 120–1500 mm per year, uniform to summer max.

Distinctive features: Small tree usually of poor form; bark box-type, to small branches in *E. microtheca*, half-barked in *E. coolabah*, wholly smooth in *E. victrix*, inflorescences of terminal panicles; fruits small, with an obscure disc.



Eucalyptus coolabah (c), *E. microtheca* (m), *E. victrix* (v) 1. Stand, near Wilcannia, N.S.W. (c) 2. Seedling 3. Adult leaf venation 4. Fruits 5. Adult leaves 6. Intermediate leaves 7. Juvenile leaves 8. Buds 9. Stand, Gascoyne River, W.A. (v) 10–12. Variation in bark (c) 13. Bark (v)

Bimble Box Poplar Box

Eucalyptus populnea F. Muell.

Bimble box is a small to medium-sized tree, usually in the range 8–20 m in height and up to 0.8 m in dbh. It commonly has a trunk of relatively poor form one-third to about half the tree height, with a medium-sized, compact crown.

Bimble box is typically a species of the hot, low rainfall, pastoral and western fringe of the wheat country of inland New South Wales where it is most common in the north-eastern sector of the western plains, and of a large area of central and eastern Queensland from Barcaldine and west of Mackay southwards, nearing the coast in the dry country around Rockhampton.

This species is characteristically found on inland plains and gentle slopes, but extends to broad valleys and coastal plains in the far north-eastern area of its occurrence. Especially in the driest parts, it also grows on flats likely to be waterlogged in the rainy season. It is most common on reddish loams of light texture but is one of the few trees, growing on black soils, which crack markedly during the dry season. The subsoils are mainly clay, often of heavy texture.

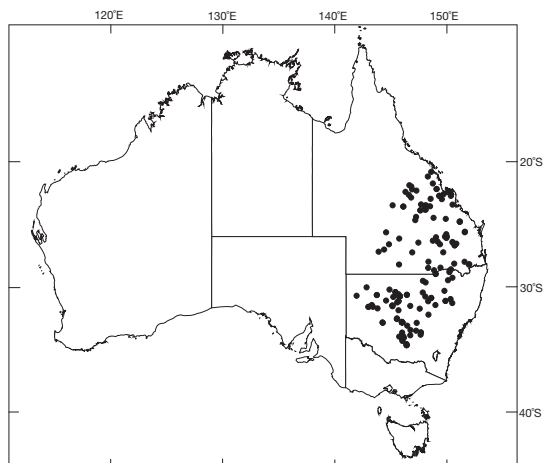
Poplar box grows in woodlands or low woodlands often associated with ironbarks (*E. crebra*, *E. melanophloia*), ghost gum (*E. aparrerinja*), carbeen (*E. tessellaris*) and coolibah (*E. coolabah*), and species of other genera such as mulga (*Acacia aneura*), brigalow (*A. harpophylla*), *Callitris*, *Casuarina*, *Geijera* and *Senna*. In many areas it grows in almost pure and fairly dense stands.

Related species: Bimble box is one of the boxes that are difficult to relate to other species. (Brooker 2000) placed it in subseries *Amissae* due to the early loss of the outer operculum, but further relationships are obscure, apart from its obvious connection with Brown's box (*E. brownii*). This species intergrades with poplar box to the north over a range of about 100 km. It shares the very glossy, green adult leaves and small buds and fruits of poplar box, but *E. brownii* has long narrow adult leaves, which easily distinguish it. Johnson and Hill (1990) divided bimble box into two subspecies based on the shape of the adult leaves. Subsp. *bimbil* is the southern form which has narrower, apiculate adult leaves and includes all of the New South Wales populations.

Publication: *J. Proc. Linn. Soc. Bot.* 3, 93 (1859). Type: Wide Bay district, Queensland, J.C. Bidwill 76. (Note: Wide Bay is south-east of Maryborough; the type was presumably collected some distance inland from this area, as the natural distribution of *E. populnea* does not approach the coast at this latitude.)

Names: Botanical Latin *populneus* (poplar-like) alluding to the leaf shape (particularly juvenile). Common *bimbil* is the Aboriginal name for this species and *box* refers to the box group of eucalypts.

Bark: Box-type, persistent on the trunk and larger branches, subprous, light grey or brown, often with patches of different shades, especially through the newly exposed whitish areas among the dominant, older weathered bark.



Leaves: Seedling—opposite for a few pairs then alternate, petiolate, elliptical to ovate, 4–10 × 1.4–5.5 cm, green, concolorous. Juvenile—alternate, petiolate, ovate to orbicular, often wider than long, often emarginate, 4.5–11.5 × 4–9.5 cm, glossy green, concolorous. Intermediate—alternate, petiolate, elliptical or sometimes spatulate, 7–16 × 3–6 cm, glossy green, concolorous. Adult—alternate, petiolate, deltoid or ovate to broad-lanceolate, 4–11 × 1.5–5 cm, glossy green, concolorous.

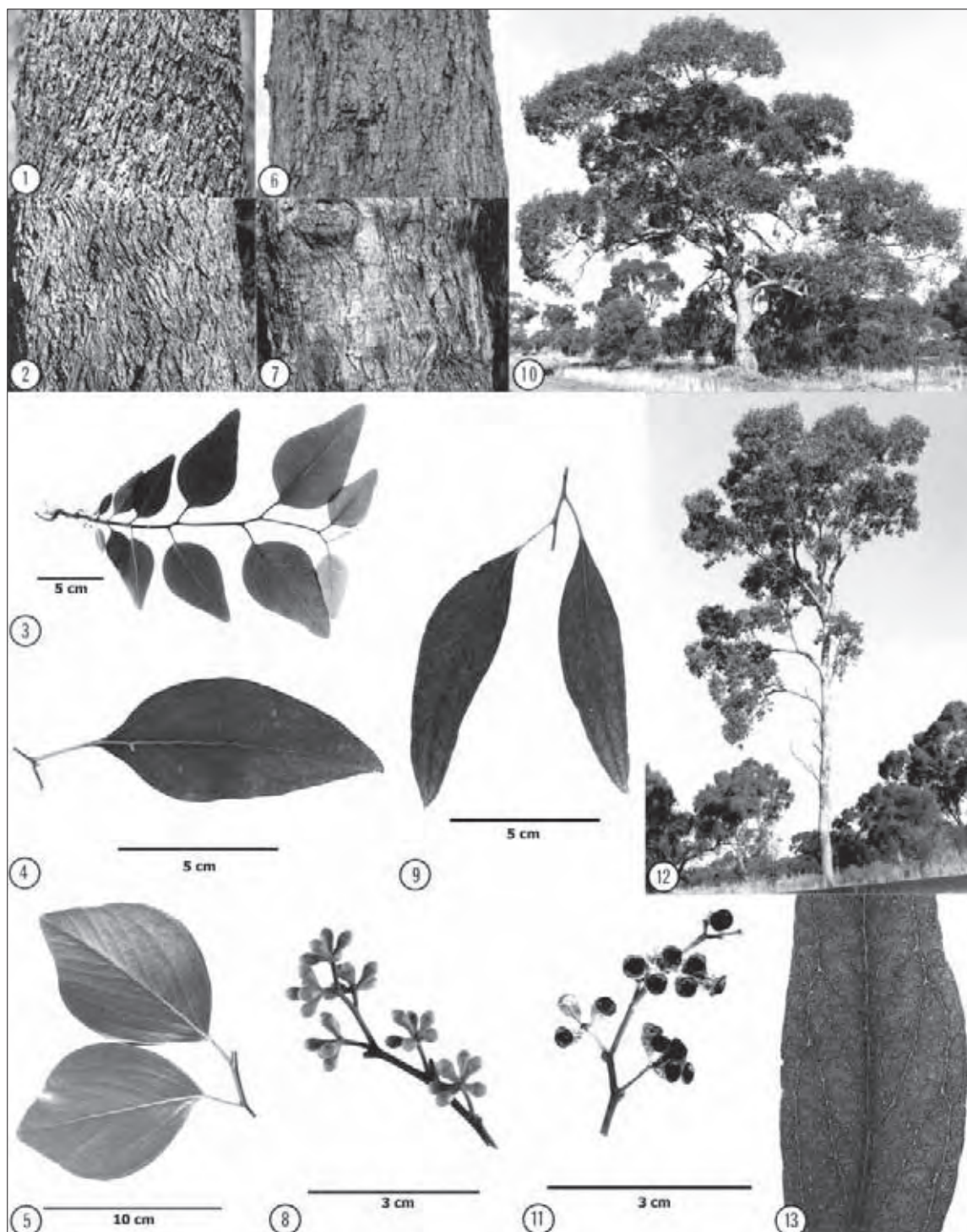
Inflorescences: Terminal panicles or subterminal axillary panicles, unit inflorescences 7–15 or more flowered; peduncles more or less terete to slightly angular, 0.4–1.1 cm long; pedicels 0.1–0.3 cm long or sometimes absent; buds clavate, 0.3–0.5 × 0.2–0.3 cm; opercula hemispherical. Flowers Feb.–Mar.

Fruits: Usually pedicellate, occasionally sessile, ovoid or hemispherical to subglobular, 0.2–0.4 × 0.2–0.4 cm; disc narrow, more or less level to descending; valves usually 4, to rim level or slightly enclosed. Seeds compressed-ovoid, often pointed at one end, brown or grey, hilum ventral.

Wood: Sapwood paler than heartwood and susceptible to *Lyctus* borer attack; heartwood pale brown to dark brown with dull red-brown hue, hard, highly interlocked grain, strong and durable; basic density 820–885 kg m⁻³; grain wavy; used for Prewood and fencing. It is a good shade and shelter species.

Climate: Altitudinal range: 100–500 m; Hottest/coldest months: 31–37°C/2–9°C; Frost incidence: low to moderate (may be up to 20 or more each year); Rainfall: 350–1000 mm per year, uniform to summer max.

Distinctive features: Adult leaves deltoid to ovate, glossy green, producing an easily recognised canopy, which is glistening in sunlight; box-barked; petioles slender; juvenile leaves orbicular; inflorescences of small terminal panicles; buds and fruits very small; regenerates vigorously and forms dense copses.



Eucalyptus populnea 1, 2, 6, 7. Bark 3. Seedling 4. Intermediate leaf 5. Juvenile leaves 8. Buds 9. Adult leaves 10, 12. Trees, near Cobar, N.S.W. 11. Fruits 13. Adult leaf venation

Black Box

Eucalyptus largiflorens F. Muell.

Black box is a small to medium-sized tree, usually within the range 10–20 m in height and up to 1 m dbh. The trunk is often of poor form and one-quarter to less than half the tree height, and the crown is open, wide spreading and of irregular shape.

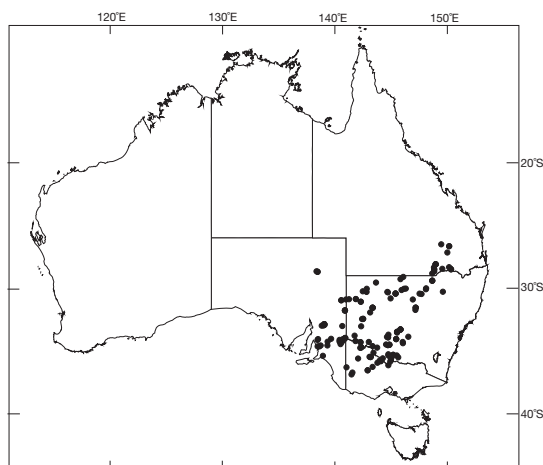
Black box occurs mainly in flat country in the vicinity of watercourses of the Murray–Darling system of New South Wales. In southern Queensland it has a scattered distribution, south-west of Miles, north of Goondiwindi, east and south of St George and a few sites to the west as far as Currawunya, south-west of Cunnamulla. It occurs along the flood plains of watercourses of northern and north-western Victoria west from Nathalia and north of Edenhope, and south-west into South Australia, from the southern Strzelecki Desert and along or near the Murray River as far south as Clayton near Lake Alexandrina. There are some scattered occurrences on heavy soil flood plains of the Gawler River north-west of Adelaide and an outlier occurs at Etadunna Station west of Lake Eyre.

Black box is typically a species of low-lying areas, e.g. broad river flats, depressions in otherwise treeless plains and silted lake beds and, in general, on any ground subject to occasional flooding, to just above the edges of flood plains. The most common soils are grey clay loams, occasionally dark grey, self-mulching clays and, less commonly, fine red-brown sands. Clay is usually near the surface and the drainage is poor.

Black box grows in woodlands or low woodlands. It usually occurs near river red gum (*E. camaldulensis*), which occupies the lowest areas adjacent to both permanent and intermittent streams, but there may be an adjacent zone where the two species are mixed. On other flat, poorly drained areas usually with heavy soils, black box may occur in almost pure open stands, particularly in the southern arid and semi-arid areas of New South Wales. It may also occur with coolibah (*E. coolabah*), which becomes more dominant towards the north of the State. In the far north-west, between the Paroo River and Cuttaburra Creek, coolibah is replaced by another box, yapunyah (*E. ochrophloia*). Elsewhere there are few eucalypts, though there may be a number of smaller trees such as myall (*Acacia pendula*) and cooba (*A. salicina*).

Related species: Brooker (2000) placed black box in subseries *Amissae*, due to the early loss of the outer operculum, and in supraspecies *Opacae* with three other boxes. It is not obviously related to another species and there is ambiguity about the outer operculum loss, as it appears to occur sometimes early sometimes late in bud development. The juvenile leaves are distinctive in the field being long, narrow, curved and blue-grey. The flowers sometimes age to pinkish.

Publication: *J. Proc. Trans. Vic. Inst.* 1, 34 (1855). Type: Murray River, above Moorundie, S.A., 1 Feb. 1851, F. von Mueller.



Names: Botanical Latin *largus* (abundant), *florens* (blooming), referring to the flowering habit. Common name possibly refers to the dark colour of the rough bark as well as to the box group of eucalypts.

Bark: Box-type, persistent on the trunk and to the small branches, hard, rugged, dark grey.

Leaves: Seedling opposite for 6–8 pairs, then alternate, petiolate, lanceolate to linear, 4.5–15 × 0.8–1 cm, green, slightly discolorous or concolorous. Juvenile alternate, petiolate, lanceolate to linear, 10–15 × 0.7–1 cm, bluish green, concolorous. Adult alternate, petiolate, narrow-lanceolate, 9–18 × 0.9–1.8 cm, green or greyish green, concolorous.

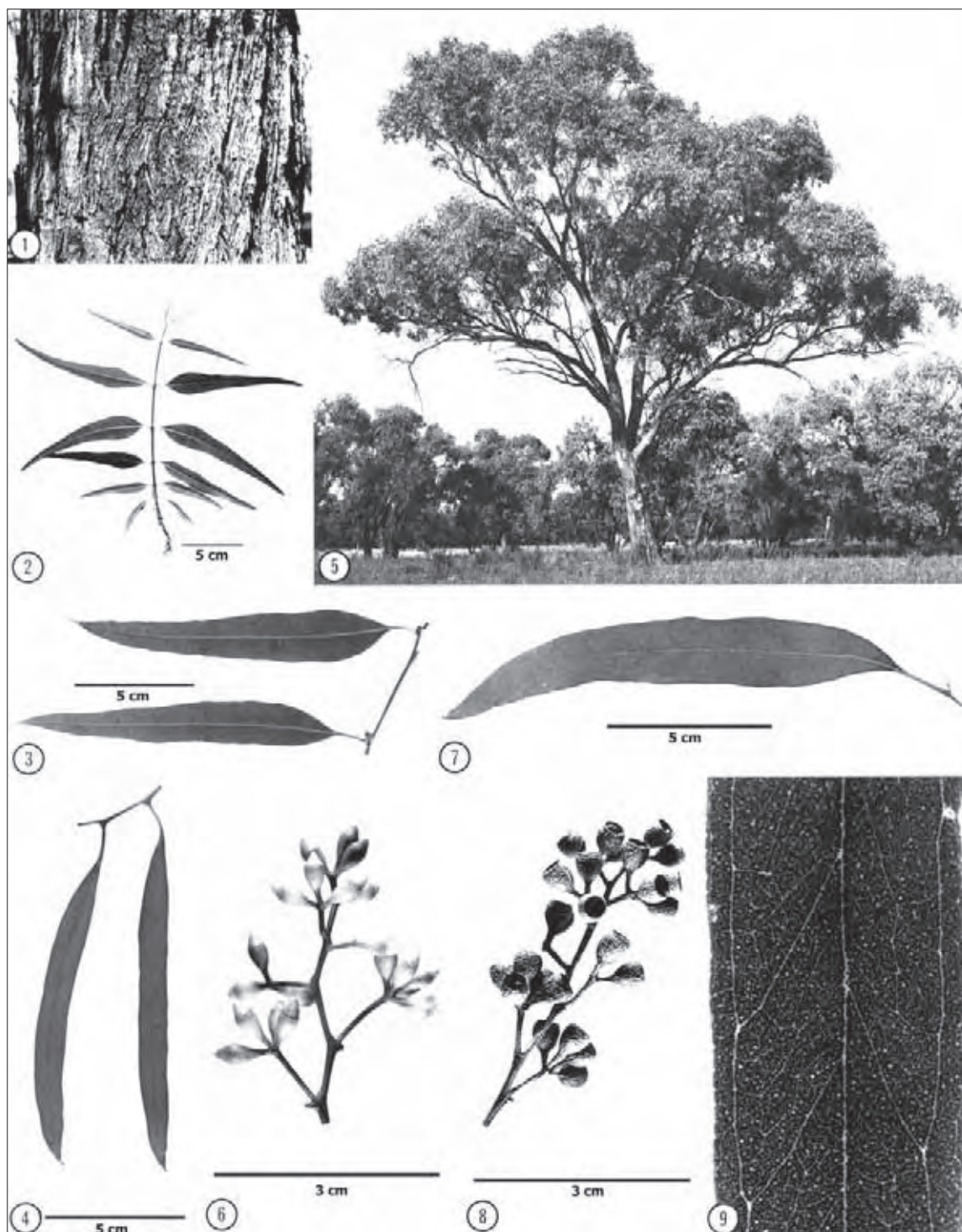
Inflorescences: Axillary or terminal panicles, unit inflorescences 7 to 11-flowered; peduncles more or less terete to slightly angular, 0.3–1.1 cm long; pedicels usually angular, 0.1–0.5 cm long, occasionally absent; buds ovoid, 0.3–0.5 × 0.2–0.3 cm, usually with faint ribs from the pedicels continuing along the hypanthia; opercula hemispherical-apiculate or conical. Flowers Aug.–Jan.

Fruits: Usually pedicellate, hemispherical to ovoid rarely obconical, 0.3–0.6 × 0.3–0.5 cm; disc narrow, descending; valves (3)4, to rim level or enclosed. Seeds ovoid or compressed-ovoid, black, grey or brown, hilum ventral.

Wood: Sapwood susceptible to *Lyctus* borer attack; heartwood pink to reddish brown, hard, heavy, durable; density about 1090 kg m⁻³, used for posts, small poles and railway sleepers.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 29–35°C/3–5°C; Frost incidence: low to moderate (up to about 15 or more each year in colder areas); Rainfall: 200–570 mm per year, winter max., uniform, summer max.

Distinctive features: Usually a straggly box tree of black soil riverine plains; box bark becoming thick and shaggy on older trees; buds and fruits very small; juvenile leaves lanceolate to linear.



Eucalyptus largiflorens 1. Bark 2. Seedling 3. Juvenile leaves 4. Adult leaves 5. Tree, near Hillston, N.S.W.
6. Buds 7. Intermediate leaf 8. Fruits 9. Adult leaf venation

Coowarra Box

Eucalyptus cambageana Maiden

Coowarra box is usually a medium-sized tree, to 25 m tall, but sometimes attains 35 m in height with dbh to more than 1 m. It is generally of reasonable form with a trunk from one-third to two-thirds of the tree height, and steeply ascending branches with a fairly open crown.

Coowarra box occurs over a large area of eastern central Queensland from west of Townsville southwards to Rockhampton and Taroom and inland to the Charleville, Tambo and Jericho areas.

This species occupies flats and rolling lowlands, which receive run-off from adjacent slopes and extends to low hills but not to steeper and rockier slopes. Soils vary from dark, uniform texture clays, red-brown clay loams to red sandy loams.

Coowarra box occurs mostly in woodlands or tall woodlands often associated with brigalow (*Acacia harpophylla*), bimble box (*E. populnea*), narrow-leaved red ironbark (*E. crebra*), grey box (*E. moluccana*), Thozet's box (*E. thozetiana*), silver-leaved ironbark (*E. melanophloia*), belah (*Casuarina cristata*) or wilga (*Geijera parviflora*).

Related species: Brooker (2000) placed Coowarra box in subseries *Amissae*, due to the early loss of the outer operculum, and in supraspecies *Cambageanae*. It is not obviously related to other species and is conspicuous in the field by its thick blackish rough bark on the lower trunk, the glossy green adult leaves and the obconical fruits with a whitish pellicle on the descending disc. This combination of characters distinguishes it from any other species.

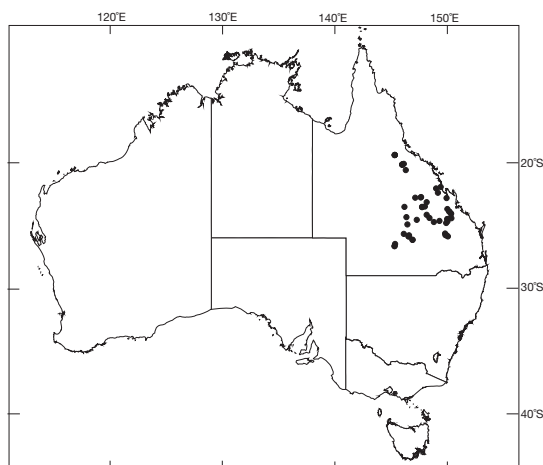
Publication: *J. Proc. Roy. Soc. N.S.W.* 47, 91 (1913). Type: Mirtna Station, south of Charters Towers, Queensland, Jan. and Dec. 1912, Zara Clark.

Names: Botanical honours R.H. Cambage (1859–1928), surveyor, geologist and botanist in New South Wales. Common refers to a district in which the species is abundant and to the box group.

Bark: Typically, rough bark is retained on the lower one-quarter to three-quarters of the trunk, but occasionally persists to the base of the largest limbs. There is usually an abrupt line of demarcation between the smooth white or dull greyish bark above the dark grey to black, subbrous, somewhat box-like, often tessellated lower bark.

Leaves: Seedling opposite for 3 or 4 pairs then alternate, petiolate, ovate, 5.1 × 2.8–6 cm, green, slightly discolorous. Juvenile alternate, petiolate, ovate, 10.5–14.5 × 4.5–8.5 cm, green, concolorous. Intermediate alternate, petiolate, ovate to broad-lanceolate, 11–22 × 2–4.5 cm, green, concolorous. Adult alternate, petiolate, lanceolate to narrow-lanceolate, 9.5–17 × 1.1–2 cm, green, concolorous.

Inflorescences: Terminal panicles, unit inflorescences 7-flowered; peduncles terete to angular, 0.4–1.1 cm long; pedicels stout, angular, 0.2–0.6 cm long; buds clavate, fusiform or ovoid, 0.4–0.7 × 0.35–0.4 cm, with ribbed or angled hypanthia; opercula hemispherical to conical. Flowers Dec.–Jan.

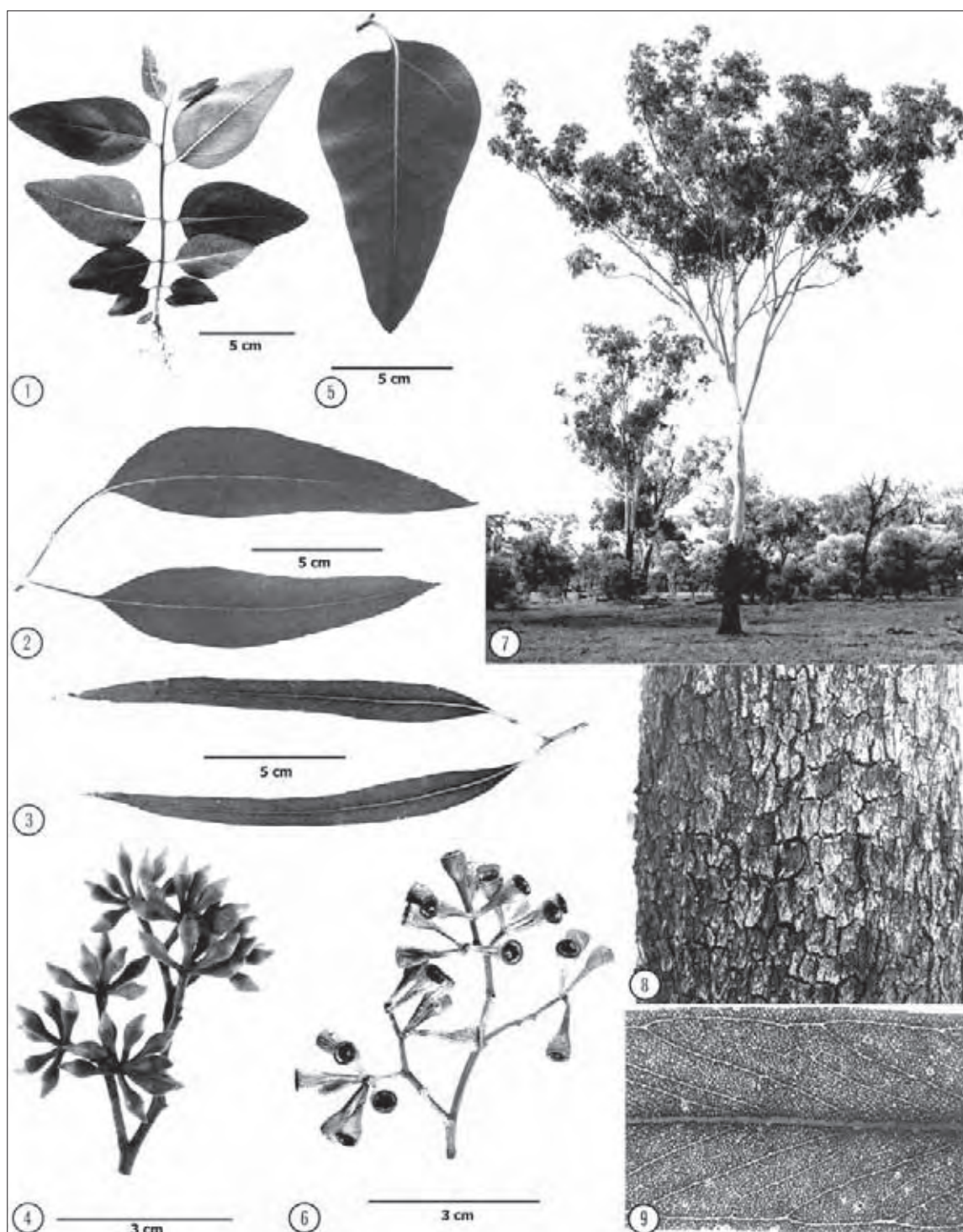


Fruits: Pedicellate, obconical, 0.4–0.7 × 0.3–0.5 cm, often with faint ribs continuing from angular pedicels; disc more or less level to descending, with a partially deciduous white tissue (pellicle); valves (4)5, usually enclosed often flat-topped. Seeds compressed-ovoid, grey, black or brown, hilum ventral.

Wood: Heartwood deep red or chocolate brown, heavy, very hard, strong and durable; density about 1130 kg m⁻³, used locally to a limited extent for farm requirements.

Climate: Altitudinal range: near sea level to 500 m; Hottest/coldest months: 30–34°C/3–11°C; Frost incidence: low to moderate (up to 15 each year at inland sites); Rainfall: 500–860 mm per year, summer max.

Distinctive features: A medium-sized tree with contrasting upper and lower bark as the most striking field feature of this species, making it readily recognisable in the field. The white disc of the fruits is a comparatively rare feature in the genus.



Eucalyptus cambageana 1. Seedling 2. Intermediate leaves 3. Adult leaves 4. Buds 5. Juvenile leaf 6. Fruits
7. Tree, north of Tambo, Qld 8. Bark 9. Adult leaf venation

Gum-barked Coolibah Smooth-barked Coolibah, Western Red Box

Eucalyptus intertexta R.T. Baker

Gum-barked coolibah is usually a small to medium-sized tree 5–20 m tall but occasionally attains 30 m in height and 1 m dbh. Form is usually only moderate on most sites. On the poorer sites it occurs as a straggly mallee.

This species occurs widely in the western plains of New South Wales extending south to the Murray River at Euston; in Queensland from north of Augathella in a narrow band of country south-eastwards towards the New South Wales border with a smaller occurrence east of St George; in South Australia north of the Murray River and in the Flinders Ranges west of Lake Frome and west of Port Augusta; in the southern part of the Northern Territory, with a very small extension into the Giles–McCarthy area of Western Australia.

Most of the occurrence is on the slightly higher parts of extensive plains, from which floodwater is shed, but in the driest parts it is found on flats and in broad valleys. It occurs in mostly sandy, well-drained soils. In western New South Wales it is considered an indicator of acid soils of light texture, while in central Australia it is usually associated with somewhat alkaline soils.

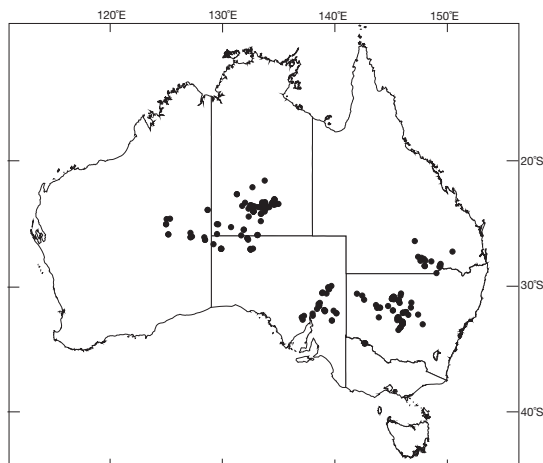
Gum-barked coolibah grows mainly in woodlands or low woodlands with associated tree species including river red gum (*E. camaldulensis*), inland grey box (*E. microcarpa*), bimbale box (*E. populnea*), white mallee (*E. dumosa*), warilu or blue mallee (*E. gamophylla*), white cypress pine (*Callitris glaucophylla*) and mulga (*Acacia aneura*).

Related species: Brooker (2000) placed gum-barked coolibah in subseries *Amissae*, due to the early loss of the outer operculum. It is closest to mountain coolibah (*E. orgadophila*), which occurs east of gum-barked coolibah in Queensland. It differs by the smaller stature, the larger buds, leaves and fruits and by its rough usually grey bark. Yellow box (*E. melliodora*) and gum-barked coolibah can look remarkably similar in habit and bark and their distributions overlap. Small mallee forms of gum-barked coolibah in the Everard Range of South Australia, west to the Blackstone Range and the Gibson Desert of central eastern Western Australia require more study to assess their taxonomic status.

Publication: *Proc. Linn. Soc. N.S.W.* 25, 308 (1900). Type: Dubbo to Darling R., New South Wales, W. Baeuerlen, plus numerous syntypes in Nymagee, Condobolin, New South Wales, Jul. 1899, R.H. Cambage; Mt Hope, New South Wales, R.H. Cambage; Cobar, New South Wales, R.H. Cambage; Drysdale, New South Wales, Jul. 1899, R.H. Cambage; Bobadah, 30 miles [48 km] E of Nymagee, New South Wales, R.H. Cambage; Nyngan, New South Wales, 7 Dec. 1899, collector unknown.

Names: Botanical Latin *inter* (between), *textus* (tissue), refers to the wood. Presumably common coolibah is of Aboriginal origin while gum-barked refers to the greater amount of smooth bark for this species compared with *E. coolabah*.

Bark: On the lower part of the trunk, compact, thick, rough, then becoming fibrous, box-type, grey or red-brown and decorticate from the upper trunk and branches to leave a



smooth, white or blotched surface with grey or brownish markings. The extent to which rough bark persists on the trunk is extremely variable and the tree may vary from almost wholly smooth-barked to one with rough bark to the break-of-crown.

Leaves: Seedling—opposite for about 4–7 pairs then alternate, petiolate, ovate to broad-lanceolate, 3–9 × 1.3–3 cm, bluish green to greyish green, slightly discolorous. Juvenile—alternate, petiolate, ovate to broad-lanceolate, 7.5–12 × 2–4.5 cm, bluish green to greyish green, slightly discolorous, becoming concolorous. Intermediate—alternate, petiolate, broad-lanceolate, 7.5–14 × 2–3.2 cm, green, greyish green or bluish grey, concolorous. Adult—alternate, petiolate, broad-lanceolate to narrow-lanceolate, 7–14 × 1–2 cm, green, greyish green or bluish grey, concolorous.

Inflorescences: A mixture of simple axillary 7-flowered unit inflorescences and terminal panicles; peduncles angular, 0.5–1.6 cm long; pedicels slender, angular, 0.3–0.9 cm long; buds ovate to broadly fusiform, 0.35–0.9 × 0.25–0.4 cm, sometimes with faint ribs on hypanthia continuing from the angular pedicels; opercula hemispherical, hemispherical-apiculate or conical. Flowers May–July.

Fruits: Pedicellate, hemispherical, ovoid or subcylindrical, 0.4–0.9 × 0.4–0.7 cm, sometimes faintly ribbed; disc relatively broad, varying from more or less level to steeply descending; valves 4 or 5, enclosed or about rim level. Seeds ovoid or compressed-ovoid, brown, hilum ventral.

Wood: Sapwood narrow, white; heartwood red, hard, heavy, with a very interlocked grain, moderately durable in the ground; density about 1100 kg m⁻³; used for firewood and farm construction.

Climate: Altitudinal range: 50–950 m; Hottest/coldest months: 31–39°C/2–6°C; Frost incidence: moderate; Rainfall: 125–450 mm per year, uniform to summer max.

Distinctive features: One of the larger tree species in the drier areas; basal, rough bark retention very variable; adult leaves variable, green, greyish green or bluish grey; simple, axillary inflorescences or terminal panicles. Pruinescence is a very variable feature in this species.



Eucalyptus intertexta 1. Seedling 2. Buds 3. Fruits 4. Adult leaves 5. Juvenile leaves 6. Intermediate leaves 7. Tree, east of Wilcannia, N.S.W. 8. Upper bark 9. Lower bark 10. Adult leaf venation

Mountain Yapunyah Thozet's Box, Thozet's Ironbox, Napunyah, Lapunyah

Eucalyptus thozetiana F. Muell. ex R.T. Baker

Mountain yapunyah can occur as a medium-sized tree 20–25 m tall and up to 0.9 m dbh with a clear bole exceeding half the total height. On poorer, drier sites farther inland it is only a small tree 8–12 m tall with a relatively short trunk. The trunk is sometimes fluted near the base.

Mountain yapunyah has a rather scattered distribution covering a wide area of southern Queensland, south-east of Hughenden to north-west of Theodore, to west of Longreach and Cunnamulla and south-east to west of Goondiwindi. There is a highly disjunct occurrence in Northern Territory north-east of Alice Springs in the Ross River area and in Garden Station.

This species grows on the plains and undulating country of the region, and on small hills and ridges. The soils are mainly light sandy loams, derived from quartz or sandstone parent material. In Queensland it also occurs commonly on lateritic sites.

Mountain yapunyah occurs in woodlands or open forests associated with carbeen (*E. tessellaris*), bimbale box (*E. populnea*), Coowarra box (*E. cambageana*) and brigalow (*Acacia harpophylla*).

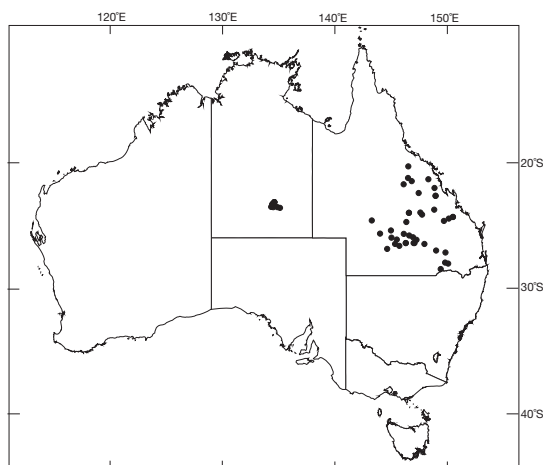
Related species: Brooker (2000) placed mountain yapunyah and its sister species yapunyah (*E. ochrophloia*) together in series *Coalitae*. The two species are not closely related to any other species in sect. *Adnataria*. The opercula of these two species appears to be united into one structure, which distinguishes them from all other species. Mountain yapunyah is readily distinguished from yapunyah (*E. ochrophloia*) by the normally smooth fluted trunk that is slightly buttressed at the base and by its non-riverine habitat. *E. ochrophloia* has a partly rough-barked trunk, broader foliage, larger buds and fruits and occurs along major drainage channels and watercourses.

Publication: *Proc. Linn. Soc. N.S.W.* 31, 305 (1906). Type: Expedition Range (south-east of Emerald), Queensland, A. Thozet.

Names: Botanical name after Frenchman Anthelme Thozet (1826–1878), a keen amateur botanist who collected extensively in the Rockhampton district. Common name Yapunyah is of Aboriginal origin while Mountain is used loosely to distinguish *E. thozetiana* from *E. ochrophloia* of low-lying country to the south-west, and which is commonly called yapunyah.

Bark: Decorticates in various sized plates to leave a predominantly white surface with bluish grey patches; frequently, parts of this decorticating bark remain attached as small black curls for some time, or in the southern part of its distribution it may be rough-barked over part or most of the bole.

Leaves: Seedling opposite for 6 or 7 pairs then alternate, petiolate, narrow-lanceolate to linear, 3–12 × 0.3–0.5 cm, green, concolorous. Juvenile alternate, petiolate, linear, 12–16 × 0.3–0.4 cm, green, concolorous. Intermediate alternate, petiolate, narrow-lanceolate, 10–15 × 1.2–1.8 cm, green, concolorous. Adult alternate, petiolate, narrow-



lanceolate, 6–15 × 0.5–1.1 cm, green, concolorous, venation sparse or obscure.

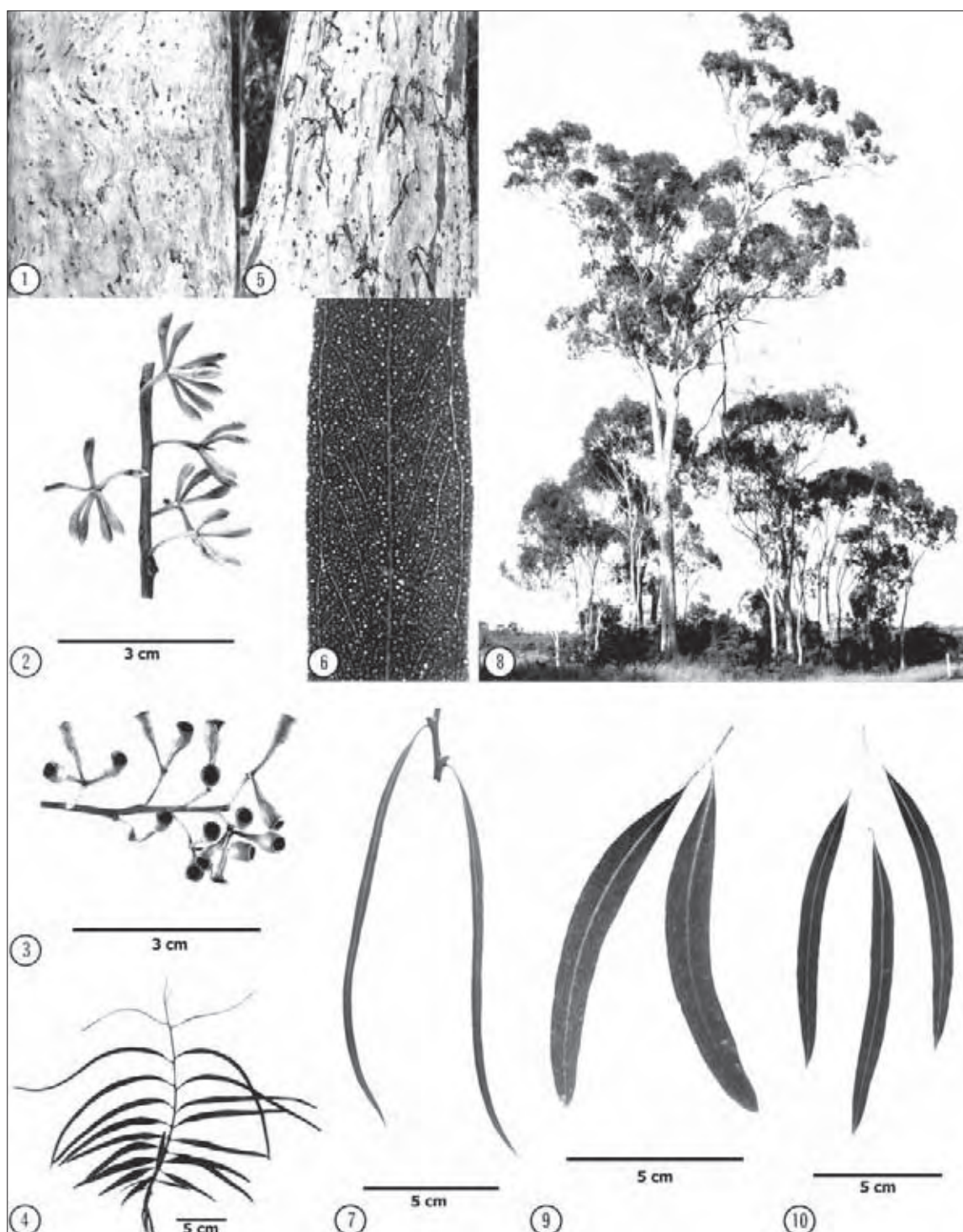
Inflorescences: Simple, axillary 7 to 11-flowered unit inflorescences or terminal panicles; peduncles more or less terete or slightly angular, 0.3–1.4 cm long; pedicels angular, 0.2–0.6 cm long, the angles continuing as faint ribs along the hypanthia and opercula; buds fusiform, 0.4–0.9 × 0.2–0.3 cm; opercula conical or slightly rostrate, inner and outer opercula united. Flowers Sept.–Nov.

Fruits: Pedicellate, truncate-ovoid to cylindrical, sometimes urceolate, occasionally almost hemispherical, 0.3–0.6 × 0.3–0.4 cm; disc broad, steeply descending; valves 3 or 4, deeply enclosed. Seeds compressed-ovoid, sometimes pointed at one end, grey, black or brown, hilum ventral.

Wood: Sapwood yellowish white; heartwood dark red-brown to almost black, texture fine and uniform, hard, heavy, durable and termite resistant; density 1015–1140 kg m⁻³; used for general construction, poles and posts.

Climate: Altitudinal range: 100–650 m; Hottest/coldest months: 32–36°C/3–10°C; Frost incidence: low to moderate (up to 15 each year in some areas); Rainfall: 290–700 mm per year, summer max.

Distinctive features: Small to medium-sized tree generally with smooth bark throughout, white with greyish blue patches; small plates or flakes of dead bark are often retained on the lower trunk (but see above); boles often prominently fluted near the base; linear juvenile leaves; leaf venation sparse or obscure; inner and outer opercula united.



Eucalyptus thozetiana 1, 5. Bark 2. Buds 3. Fruits 4. Seedling 6. Adult leaf venation 7. Juvenile leaves 8. Stand, east of Emerald, Qld 9. Intermediate leaves 10. Adult leaves

Grey Box Gum-topped Box (Qld)

Eucalyptus moluccana Roxb.

Grey box is a medium-sized tree usually attaining 20–30 m in height and around 0.6–1.2 m dbh. The trunk is generally straight, of good form and half or more of the tree height. The branches of the crown are numerous and often erect, while the foliage is moderately dense.

Grey box is most common in the drier areas of central and northern coastal New South Wales, north of the Jervis Bay area. In south-eastern Queensland it occurs along the coast and coastal hinterlands to as far north as the Mackay area. There are small disjunct northern occurrences on Lords Table Mountain, near Eungella Dam and much further north on the Atherton tableland. In the westerly parts of its distribution it grades into the inland grey box, *E. microcarpa*.

This species occurs mainly on plains and undulating country or in open valleys along the coastal belt. The soils are usually moderately heavy clays or lighter with a clay subsoil, moist but well drained and moderately fertile.

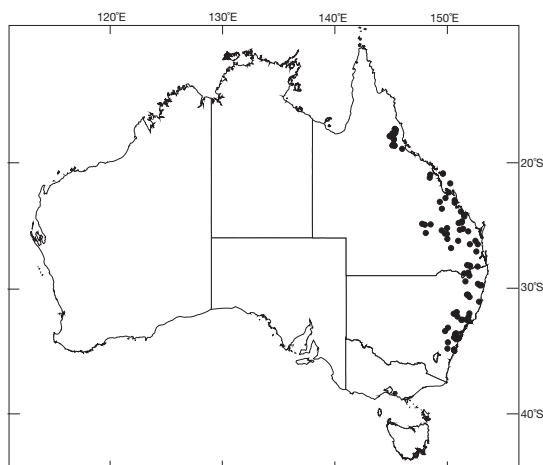
Grey box is most common in open forests and woodlands with a sparse ground cover of grasses and herbs. It occurs with many other eucalypts and is most often associated with spotted gum (*E. maculata*), lemon-scented gum (*E. citriodora*) and forest red gum (*E. tereticornis*). Less commonly it is found with narrow-leaved red ironbark (*E. crebra*), grey ironbark (*E. paniculata*), grey gum (*E. propinqua*), white mahogany (*E. acmenoides*), red mahogany (*E. resinifera*), pink bloodwood (*E. intermedia*) and sometimes tallowwood (*E. microcorys*). Other genera are represented by brush box (*Lophostemon confertus*), brigalow (*Acacia harpophylla*) and black cypress pine (*Callitris endlicheri*).

Related species: Brooker (2000) placed grey box in series *Buxaeales* (the southern and eastern boxes), subseries *Continentes*, a relatively large group of both trees and mallees that have buds which hold the outer operculum till flowering. It is closely related to the inland grey box (*E. microcarpa*), which has more rough bark, smaller buds and fruits, and a more inland distribution, and to narrow-leaved box (*E. pilligaensis*) also of inland occurrence and which differs slightly by the narrower adult leaves and smaller buds and fruits. It is clearly related to white box (*E. albens*) which is distinctive in the larger, blue-grey leaves at all stages, larger, usually pruinose buds and fruits, and characteristically blotchy box bark caused by the greater shedding of the older weathered grey rough bark exposing the inner whitish bark.

Publication: *Fl. Ind.* 2, 498 (1832). Type: No type cited; apparently described from a cultivated tree in the Calcutta Garden [India], said to be a native of the Moluccas [Muluku Province, Indonesia].

Names: Botanical wrongly attributed, as the species does not occur naturally in Indonesia. Common refers to the bark type and colour.

Bark: Box-type, persistent on the lower half only, more rarely on most of the trunk, thin, grey, held in small tessellations, somewhat mottled due to the shedding of old grey bark



exposing lighter coloured inner bark, also shedding in ribbons from top of rough bark and branches, upper bark smooth, light grey, sometimes shiny.

Leaves: Seedling opposite for about 3–7 pairs then alternate, petiolate, ovate or sometimes almost orbicular, 3–10.5 × 1.6–5.5 cm, green, discolorous. Juvenile alternate, petiolate, ovate or sometimes almost orbicular, 9–18 × 3.5–11 cm, green, discolorous. Adult alternate, petiolate, broad-lanceolate to lanceolate, 7–17 × 2–3.3 cm, green, concolorous.

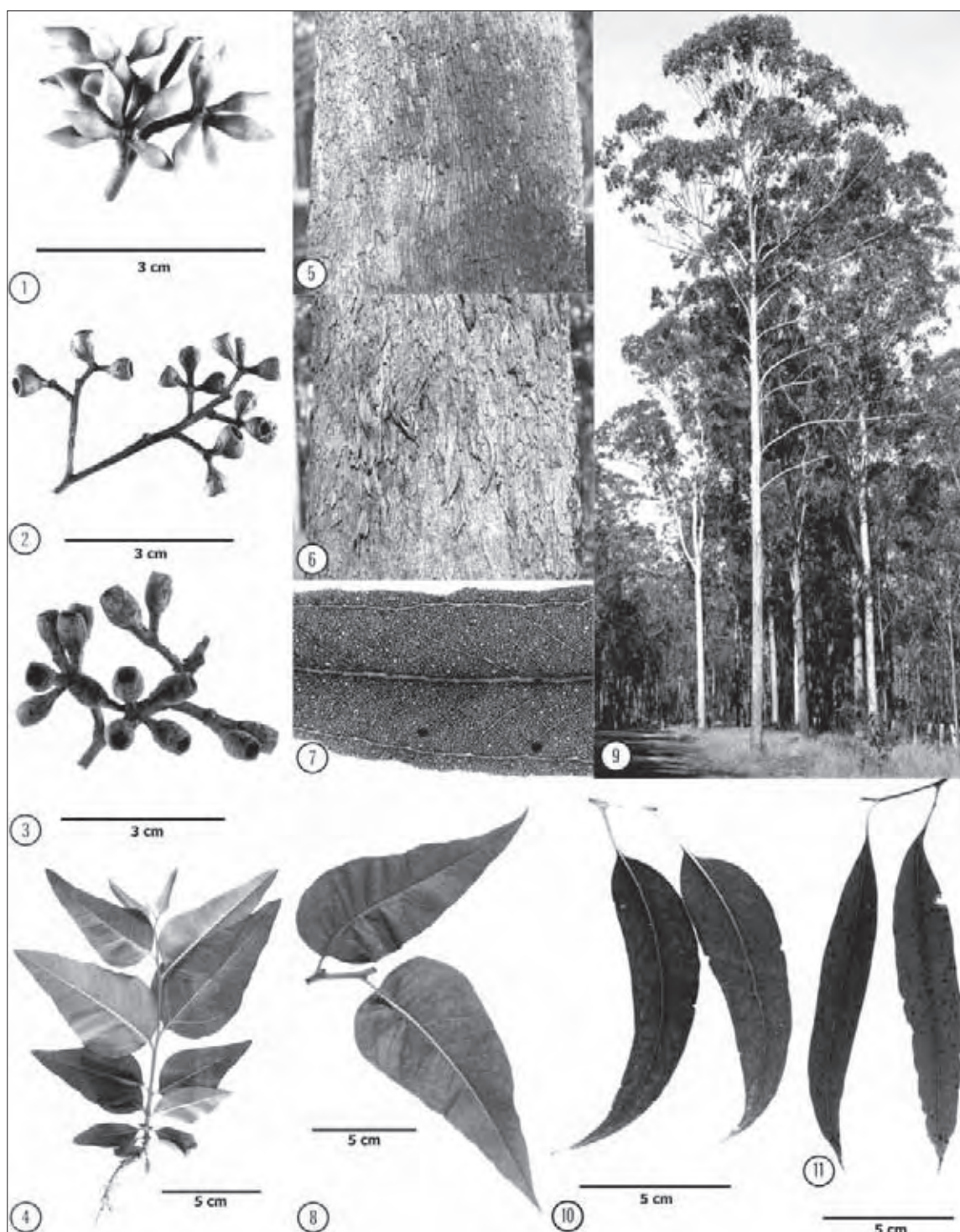
Inflorescences: Mostly terminal panicles but also simple axillary, unit inflorescences 7-flowered; peduncles terete or angular, 0.5–1.3 cm long; pedicels angular, 0.1–0.7 cm long, the angles continuing as faint ribs along the hypanthia and opercula; buds diamond-shaped to broadly fusiform, 0.8–1 × 0.3–0.4 cm; opercula conical or rostrate. Flowers Jan.–Apr.

Fruits: Pedicellate (sometimes almost sessile), cupular, barrel-shaped or slightly urceolate, 0.5–0.9 × 0.4–0.6 cm, usually faintly ribbed; disc relatively broad, steeply descending; valves usually 4, deeply enclosed. Seeds compressed-ovoid, brown to grey, hilum ventral.

Wood: Sapwood light grey-brown, resistant to *Lyctus* borers; heartwood light brown or sometimes yellowish, with fine uniform texture and generally interlocked grain, very hard, strong, termite-resistant, very durable; density 1000–1230 kg m⁻³; used for heavy engineering construction, wharves, bridges, poles, posts, housing, cross-arms, railway sleepers and general outdoor use.

Climate: Altitudinal range: near sea level to 1150 m; Hottest/coldest months: 25–33°C/0–11°C; Frost incidence: low to moderate (up to 50 each year at higher elevations); Rainfall: 670–1250 mm per year, uniform to summer max.

Distinctive features: Small to medium-sized tree with typical fine, subbrous, box-type bark persistent on the lower trunk or higher; juvenile leaves broad, ovate to nearly orbicular, up to 18 × 11 cm; inflorescences mostly terminal, paniculate; fruits barrel-shaped in southern forms, smaller and tending to be cupular in northern forms where it intergrades with *E. microcarpa*.



Eucalyptus moluccana 1. Buds 2. Fruits (Qld) 3. Fruits (N.S.W.) 4. Seedling 5, 6. Bark 7. Adult leaf venation 8. Juvenile leaves 9. Tree, Glenugie State Forest, near Grafton, N.S.W. 10. Intermediate leaves 11. Adult leaves

Inland Grey Box Grey Box, Narrow-leaved Box

Eucalyptus microcarpa (Maiden) Maiden

Inland grey box is commonly 15–25 m tall, up to 1 m dbh and at its best is of good form with a straight bole about half the tree height. On the poorest sites it may be reduced to a small, somewhat straggly tree only 8–12 m high.

Inland grey box is common in the wheat belt area of Victoria, New South Wales and Queensland. In Victoria the main area is immediately north of the Grampians in the west and the Australian Alps in the east; in New South Wales the occurrence is continuous with the lower western slopes and the eastern edges of the western plains; in Queensland it extends to near Rolleston while to the east thereof it grades into the northern form of grey box (*E. moluccana*). It has a limited occurrence in South Australia, in the southern Flinders Ranges, the Adelaide hills and plains and in the Bordertown–Naracoorte region.

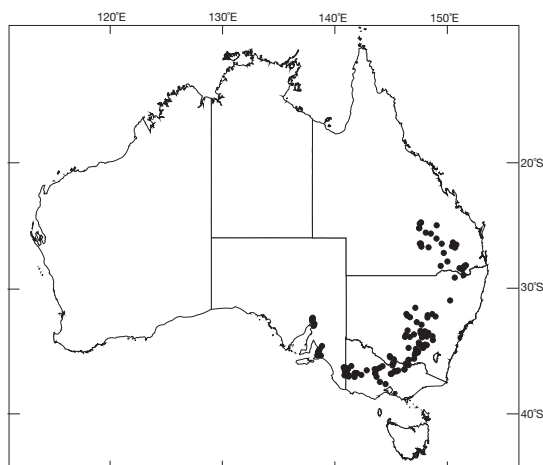
Inland grey box occurs on gentle slopes and plains and occasionally, in the driest part of the range, on dry streambeds and banks. It grows on rather heavy alluvial soils, clay loams and better quality sandy loams, sometimes with limestone in the deeper horizons.

This species occurs mainly in grassy eucalypt woodlands and is associated with yellow box (*E. melliodora*), blackly-oak red gum *E. blakelyi*, red box (*E. polyanthemus*), river red gum (*E. camaldulensis*), blue gum (S.A.) yellow gum (Vic.) (*E. leucoxylon*), red ironbark (*E. sideroxylon*) and bumble box (*E. populnea*). Acacias such as brigalow (*A. harpophylla*), casuarinas and cypress pine (*Callitris* spp.) may also be present.

Related species: Brooker (2000) placed inland grey box in series *Buxaeales* (the southern and eastern boxes), subseries *Continentes*, a relatively large group of both trees and mallees that hold the outer operculum till flowering. It is closely related to grey box (*E. moluccana*), which has less rough bark, larger buds and fruits, and a more coastal distribution, and to narrow-leaved grey box (*E. pilligaensis*) also of inland occurrence and which differs slightly by the narrower adult leaves. It is more distantly related to white box (*E. albens*) which is distinctive in the larger, blue-grey leaves at all stages, larger, usually pruinose buds and fruits, and characteristically blotchy box bark caused by the greater shedding of the older weathered grey rough bark exposing the inner bark, and in occupying higher ground. There may be problems in distinguishing it from peppermint box (*E. odorata*), which typically has terminal and axillary inflorescences and narrower juvenile leaves.

Publication: *E. hemiphloia* var. *microcarpa*: Crit. Revis. *Eucalyptus* 2, 17 (1914) and *E. microcarpa*: Crit. Revis. *Eucalyptus* 6, 438 (1923). Type: Gulgong, New South Wales, Apr. 1904, J.H. Maiden & J.L. Boorman.

Names: Botanical—Greek *micros* (small), *carpos* (fruit), presumably by comparison with *E. hemiphloia* (now *E. moluccana*) of which it was first regarded as a variety. Common—refers to its geographic occurrence in relation to its close relative grey box (*E. moluccana*) and to bark colour and type.



Bark: Box-type on the trunk and larger limbs, fine, becoming tessellated, grey, somewhat mottled due to the shedding of old grey bark exposing lighter coloured inner bark, upper branches smooth, at first often pink or whitish, weathering to grey.

Leaves: Seedling—opposite for a few pairs then alternate, petiolate, ovate, 5–9 × 2–5 cm, green or greyish green, slightly discolorous. Juvenile—alternate, petiolate, ovate, 9–15 × 3–5 cm, green or greyish green, concolorous. Intermediate—alternate, petiolate, ovate to broad-lanceolate, 9–17.5 × 2–4.5 cm, green, concolorous. Adult—alternate, petiolate, broad-lanceolate to narrow-lanceolate, 8–12.5 × 1–2 cm, green, concolorous.

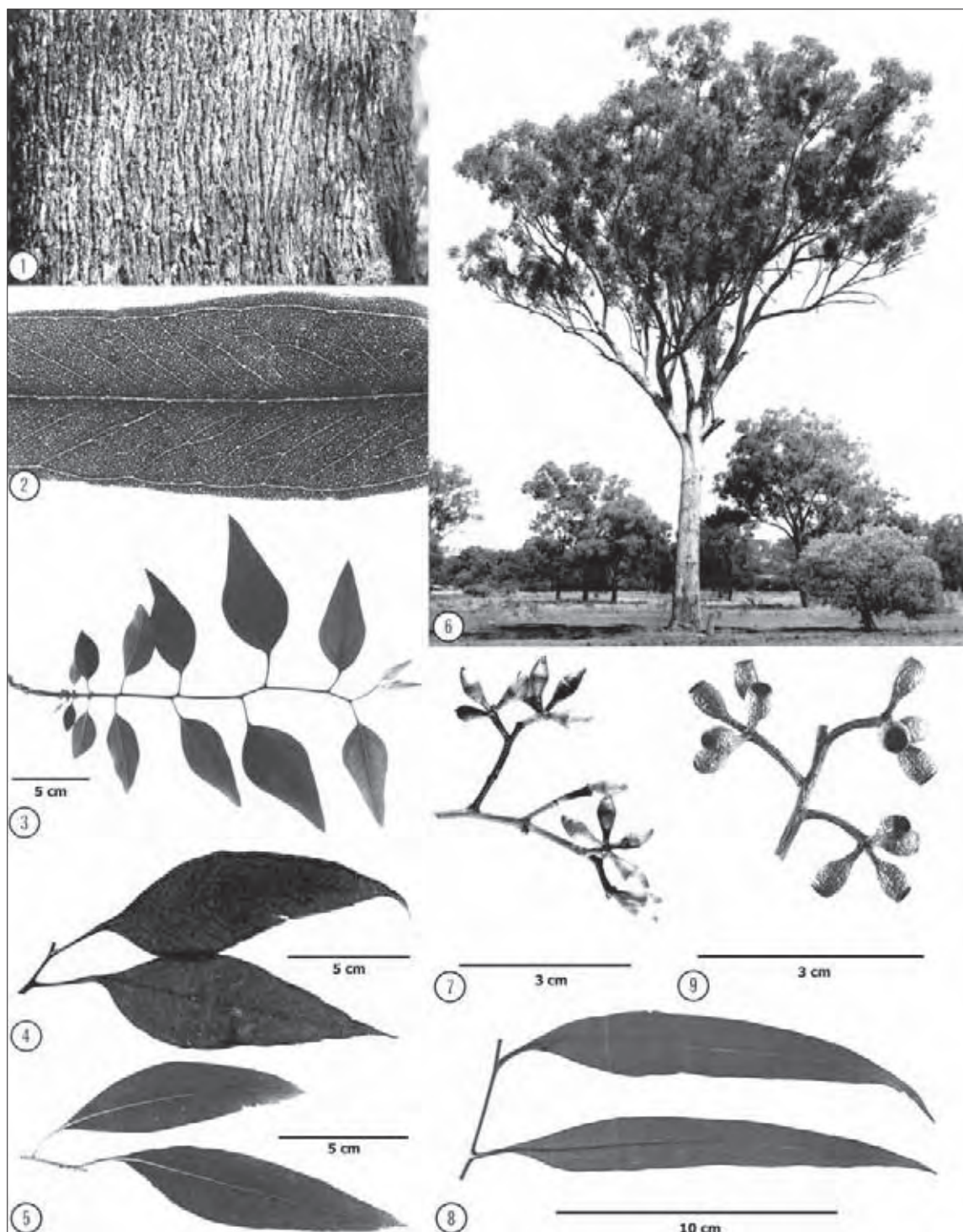
Inflorescences: Terminal panicles, unit inflorescences 7 or 9-flowered; peduncles angular, 0.3–1 cm long, the angles continuing as faint ribs along the hypanthia and opercula; pedicels sometimes absent, or angular and 0.1–0.5 cm long; buds ovoid, 0.4–0.9 × 0.25–0.4 cm; opercula conical. Flowers Feb.–Aug. and is a good honey producer.

Fruits: Sessile or shortly pedicellate, truncate, barrel-shaped, cylindrical, or rarely hemispherical, 0.3–0.7 × 0.3–0.5 cm, often faintly ribbed; disc relatively broad, descending; valves usually 4, to rim level or slightly enclosed. Seeds compressed-ovoid, often pointed at one end, black, brown or grey, hilum ventral.

Wood: Sapwood resistant to *Lyctus* borers; heartwood light brown, of fine texture, grain generally interlocked, hard, strong, extremely durable; basic density 825 kg m⁻³; used for fencing material and railway sleepers.

Climate: Altitudinal range: 40–800 m; Hottest/coldest months: 25–33°C/1–7°C; Frost incidence: moderate (5–30 each year at higher elevations); Rainfall: 400–760 mm per year, uniform, summer max., winter max. depending on distribution.

Distinctive features: Small to medium-sized tree with typical fine box-type bark on trunk and larger limbs; inflorescences of terminal panicles; buds and fruits small; juvenile leaves ovate.



Eucalyptus microcarpa 1. Bark 2. Adult leaf venation 3. Seedling 4. Juvenile leaves 5. Intermediate leaves 6. Tree, between Wallendbeen and Temora, N.S.W. 7. Buds 8. Adult leaves 9. Fruits

White Box

Eucalyptus albens Benth.

White box is commonly 15–25 m tall and 0.5–1 m dbh, with a moderately straight trunk up to half the tree height, and a strongly branched, rather large crown. On poor sites, it is smaller and of poorer form and branches lower down the bole.

White box is widely distributed on the western slopes and tablelands of New South Wales and extends into central Victoria to the north-west of Melbourne, and particularly in the ranges around the upper Snowy River. In far south-eastern Queensland it occurs in a narrow strip along the Great Dividing Range south from the Bunya Mountains to Warwick, but more broadly distributed south-west towards Texas and Inglewood. There is a minor but highly disjunct occurrence near Melrose in the southern Flinders Ranges of South Australia.

This species grows on a wide range of soils on gentle slopes and plains, broad shallow valleys and, occasionally, the lower slopes of hills and mountains, but in most situations at a higher elevation than other box species nearby.

White box is a species of grassy eucalypt woodlands often associated with other box species (*E. microcarpa*, *E. pilligaensis*, *E. conica*), yellow box (*E. melliodora*), red ironbark (*E. sideroxylon*), narrow-leaved red ironbark (*E. crebra*) and Blakely's red gum *E. blakelyi*. Other species include black cypress pine (*Callitris endlicheri*), white cypress pine (*C. glaucophylla*), casuarinas (*Allocasuarina* spp.), apples (*Angophora* spp.), *Acacia* spp. and kurrajong (*Brachychiton populneus*).

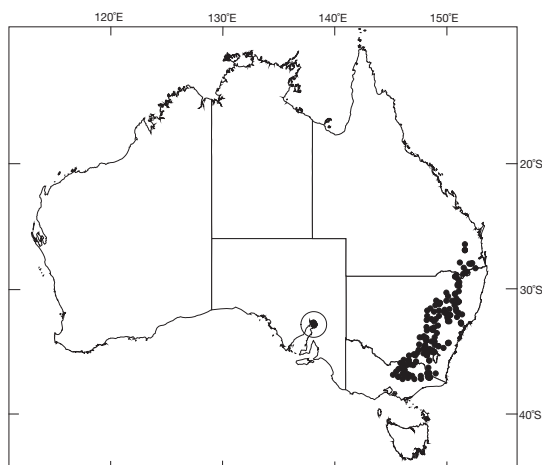
Related species: Brooker (2000) placed white box in series *Buxales* (the southern and eastern boxes), subseries *Continentes*, a relatively large group of both trees and mallees that have buds, which do not shed the outer operculum until anthesis. It is closely related to grey box (*E. moluccana*), which has less rough bark, smaller buds and fruits, and a more coastal distribution. It is more distantly related to inland grey box (*E. microcarpa*), which is distinctive in the smaller, green leaves at all stages, smaller, usually non-pruinose buds and fruits, and tends to replace white box on lower slopes.

Publication: *Fl. Austral.* 3, 219 (1867). Types: Macquarie River, Aug. 1817, A. Cunningham 198, and New England, C. Stuart, New South Wales; Broken River, F. von Mueller.

Names: Botanical Latin *albens* (white), alludes presumably either of the predominance of whitish rough bark or to the white pruinose bloom of the foliage and buds. Common names for the species epithet and to the 'box' bark type.

Bark: Box-type, persistent on the trunk, somewhat pinnate, subpinnate, often in small tessellations, light grey and usually mottled due to the common shedding of the outer grey bark exposing the inner whitish bark, decorticating over most or all of the large branches to leave a white or greyish white smooth surface.

Leaves: Seedling opposite for about 3–5 pairs then alternate, petiolate, ovate to more or less orbicular, 5–10.5 × 3–7 cm, greyish green, very slightly discoloured. Juvenile alternate,



petiolate, ovate to more or less orbicular, sometimes cordate, 9–15 × 6–11.5 cm, greyish green or bluish green, concolorous. Adult alternate, petiolate, broad-lanceolate to lanceolate, 10–16 × 1.7–3 cm, greyish green when new, usually maturing to blue-grey, concolorous. Stems and petioles are usually pruinose at all stages.

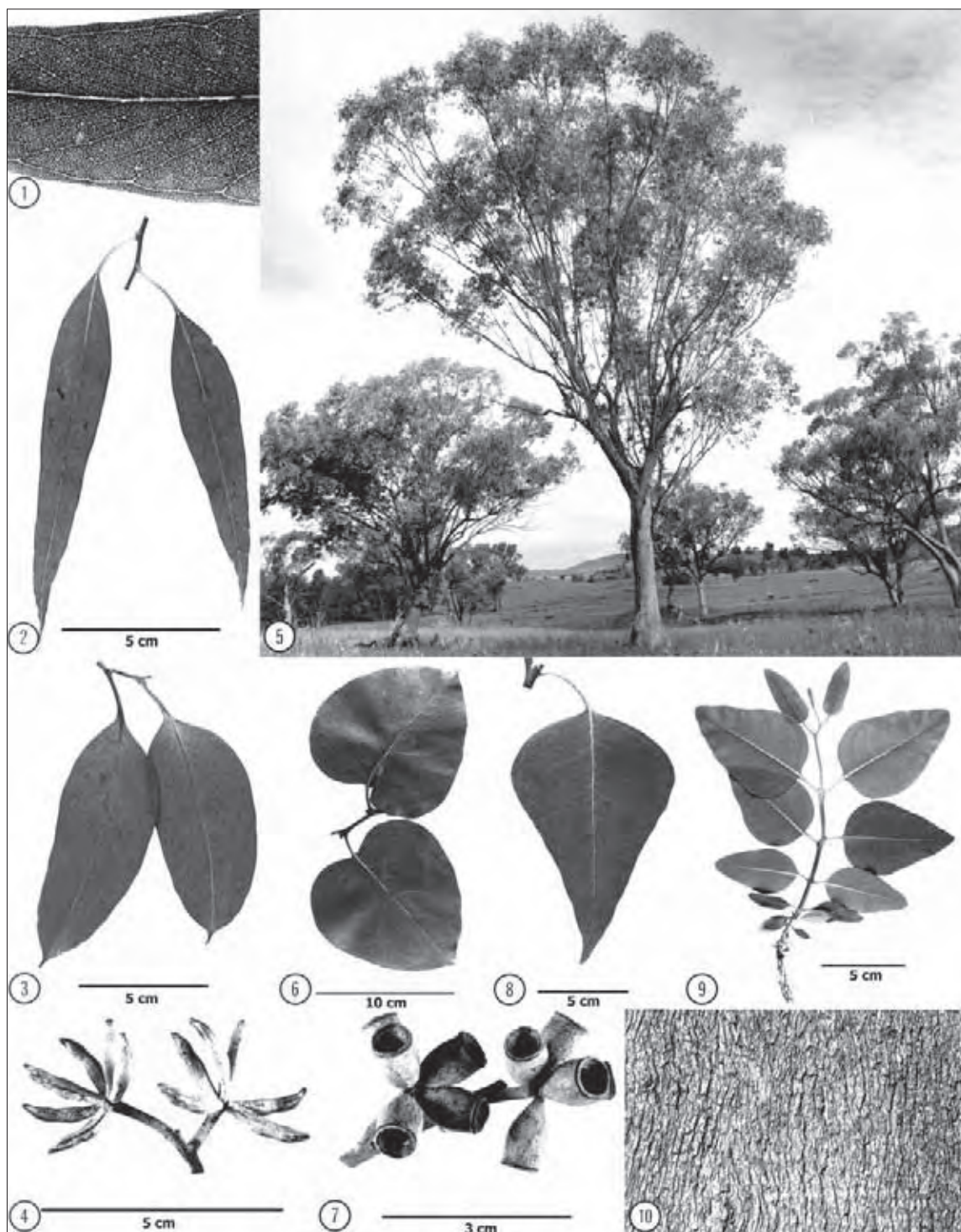
Inflorescences: Usually terminal panicles but also some simple axillary inflorescences, 7-flowered; peduncles angular, 0.7–1.8 cm long; pedicels often absent, but also 0.1–0.5 cm long, stout and angular with the angles continuing as ribs along the hypanthia and opercula; buds narrowly cylindroid, tapered at both ends, curved or bent, 1.1–1.8 × 0.3–0.6 cm, usually pruinose; opercula elongated, conical or somewhat beaked. Flowers Mar.–May and is a good honey producer.

Fruits: Sessile or shortly pedicellate, cylindroid or barrel-shaped to suburceolate, 0.6–1.5 × 0.5–1 cm, usually ribbed and pruinose; disc broad, steeply descending; valves usually 4, deeply enclosed. Seeds irregularly compressed-ovoid, sometimes pointed at one end, blackish, brown or grey, hilum ventral.

Wood: Heartwood light brown, heavy, hard, strong and moderately durable, not susceptible to *Lyctus* or termite attack, grain interlocked; density 1005–1180 kg m⁻³; used for heavy engineering construction, poles, railway sleepers, fencing and fuelwood.

Climate: Altitudinal range: 150–1200 m; Hottest/coldest months: 25–32°C/0–4°C; Frost incidence: moderate to high (5–70 each winter at higher elevations); Rainfall: 450–900 mm per year, winter max., uniform, summer max.

Distinctive features: Small to medium-sized, gum-topped box tree; trunk with typical finely tessellated box bark, the outer layers of which are characteristically shed to expose whitish patches; juvenile leaves conspicuous in the field with large, orbicular, greyish green or bluish green leaves; adult leaves fairly broad and the whole canopy blue-grey contrasting with the green canopy of the related *E. moluccana*; buds, fruits and branchlets pruinose; buds large for a box, elongated, often angled, opercula often sharply pointed and bent at the tip.



Eucalyptus albens 1. Adult leaf venation 2. Adult leaves 3. Intermediate leaves 4. Buds 5. Stand, north-east of Gunnedah, N.S.W. 6, 8. Juvenile leaves 7. Fruits 9. Seedling 10. Bark

Western White Gum Lapunyah, Chinchilla White Gum, Scrub Gum, White Gum, Burncluith Gum, Queensland Western White Gum

Eucalyptus argophloia Blakely

Western white gum is a medium-sized to tall tree, generally of excellent form, attaining 40 m in height and 1 m dbh. The trunk is clear of branches for half or more of the total tree height.

Western white gum has a very small natural occurrence in an area around 40 km long and 12–15 km wide to the north-east of Chinchilla, from Burncluith to Burra Burri in southern Queensland. Due to its limited occurrence this species has been legislated as rare and vulnerable.

This species grows on and around the edges of flats in country of low topographic relief. The soils are red loams or grey-brown clays and clay loams of moderate fertility. Much of the habitat has been developed for cropping and pasture so that little of the original forest remains.

Western white gum occurs in woodlands or open forests. Associated tree species include brigalow (*Acacia harpophylla*), white cypress pine (*Callitris glaucophylla*), belah (*Casuarina cristata*), grey box (*E. moluccana*), inland grey box (*E. microcarpa*) and bimble box (*E. populnea*).

Related species: Brooker (2000) placed western white gum with coast grey box (*E. bosistoana*) in series *Submelliodorae*. The series is somewhat taxonomically isolated and the two species are widely separate in distribution, *E. bosistoana* being a coastal species from southern New South Wales and eastern Victoria. Both can be very tall trees and their fruits have 5 or 6 valves. Coast grey box differs in having thin, box-type bark on the lower trunk, and larger buds and fruits. In its area of natural distribution, western white gum could not be confused with any other species due to its impressive size and smooth bark.

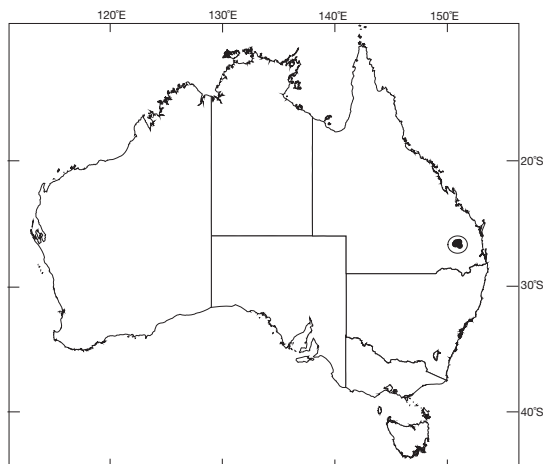
Publication: *Key Eucalypts*, 256 (1934). Syntypes: About 12 miles north of Chinchilla, Queensland, May 1933, R.C. Beasley; Chinchilla, Apr. 1933, R.C. Beasley.

Names: Botanical—Greek *argos* (bright, white), *phloios* (bark); both botanical and common names refer to the bark.

Bark: A smooth gum bark, decorticating in strips to expose a whitish undersurface; older bark has colourful pinkish grey, bluish grey, brown and yellowish patches at time of bark shed (early winter); bark is shed to ground level on most trees though some retain a metre or so of undecorticated greyish flaky bark at the base.

Leaves: Seedling—opposite for a few pairs then alternate, lanceolate to narrow-lanceolate or linear, 2.5–7 × 0.3–1.5 cm, greyish green, slightly discoloured. Juvenile—alternate, petiolate, linear to narrow-lanceolate, 7–9 × 0.3–1.4 cm, greyish green, slightly discoloured. Intermediate—alternate, petiolate, lanceolate or narrow-lanceolate, 10–14 × 1.5–2.5 cm, green, concolorous. Adult—alternate, petiolate, narrow-lanceolate, 8.5–13 × 0.8–1.3 cm, green, concolorous. The intramarginal vein in all leaf stages is conspicuously remote from the leaf edge.

Inflorescences: Usually simple, axillary but sometimes apparently terminal, unit inflorescences 7-flowered; peduncles more or less terete to angular; 0.4–0.8 cm long; pedicels 0.1–



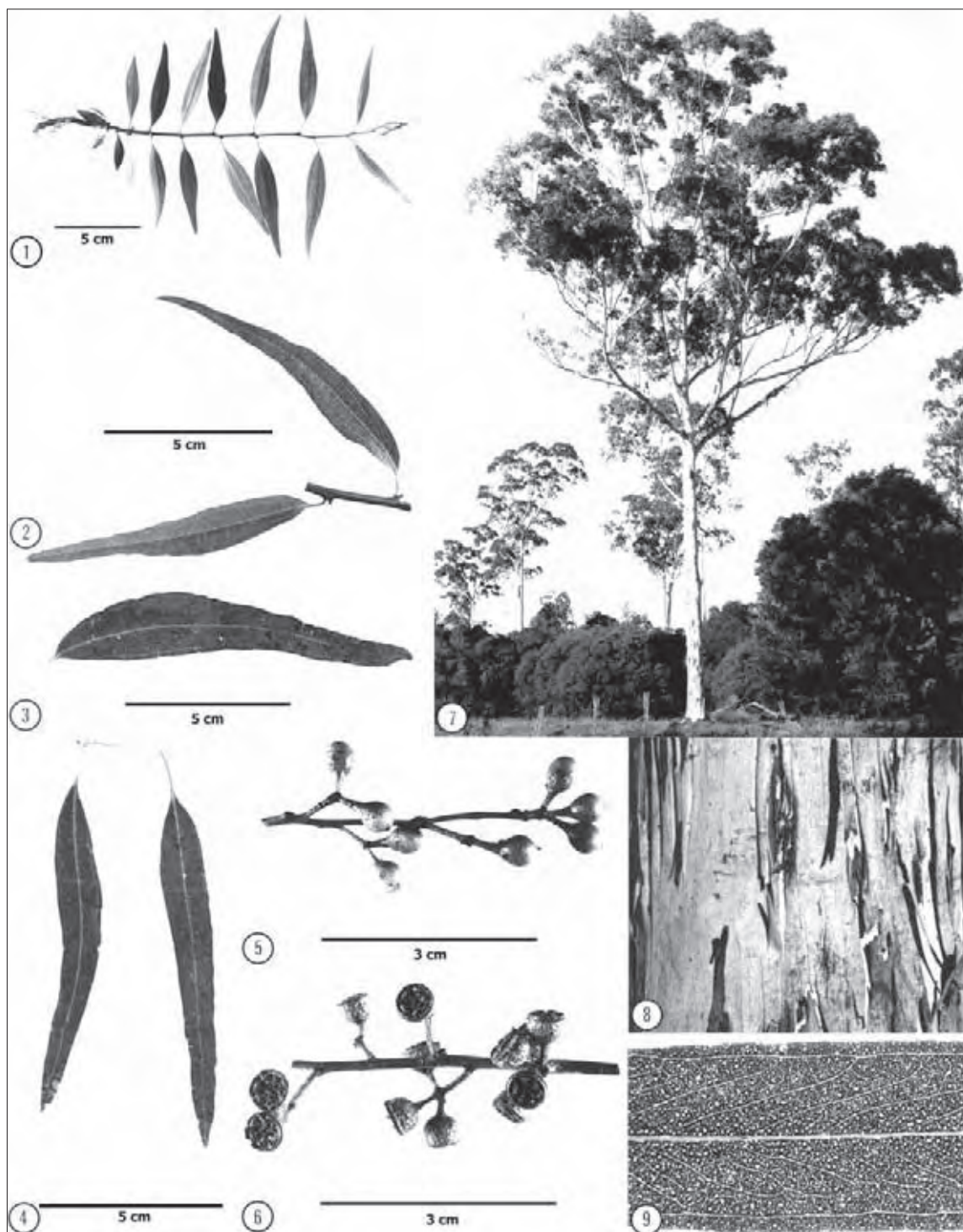
0.5 cm long; buds ovoid or almost globular, 0.35–0.4 × 0.3–0.4 cm; opercula hemispherical, occasionally apiculate. Flowers May–June.

Fruits: Pedicellate, hemispherical to cupular, 0.35–0.5 × 0.4–0.7 cm; disc of medium width, more or less level, valves 5 or 6, varying from very slightly exerted to very slightly enclosed. Seeds ovoid, blackish, brown or grey, hilum ventral.

Wood: Heartwood deep red or red-brown, sapwood paler and susceptible to *Lyctus* borers; hard, strong, durable; density 1055 kg m⁻³; in the past it was used locally for fencing and general construction; currently there are restrictions on harvesting timber from natural stands due to its conservation status; plantations for timber and seed production have recently been established.

Climate: Altitudinal range: 300–340 m; Hottest/coldest months: 31–32°C/3–4°C; Frost incidence: moderate (10–15 each winter at higher elevations); Rainfall: 650–700 mm per year, summer max.

Distinctive features: The tall, erect habit and smooth white bark make this tree very distinctive in its limited natural habitat; fruits commonly with 5 or 6 valves; remote intramarginal vein in all leaf stages.



Eucalyptus argophloia 1. Seedling 2. Juvenile leaves 3. Intermediate leaf 4. Adult leaves 5. Buds 6. Fruits 7. Tree, Burra Burra, north-east of Chinchilla, Qld 8. Bark 9. Adult leaf venation

Coast Grey Box Gippsland Grey Box (Vic.)

Eucalyptus bosistoana F. Muell.

Coast grey box is the largest of the 'box group' of eucalypts. It is commonly 30–40 m tall and up to 1.5 m dbh while some trees may attain 60 m. The trunk is usually of good form and more than half the tree height, the crown being relatively small and compact. On the higher altitude, poorer sites it is often an umbrageous tree of relatively poor form.

This species grows mainly in the coastal areas of eastern Victoria and of New South Wales south of Sydney. The most important occurrence is in the Cann River area of Victoria. While generally a lowland coastal species growing near rivers and streams, it also occurs on the Southern Tablelands of New South Wales, e.g. between Goulburn and Bungonia, south along the lower eastern slopes of the tablelands to eastern Gippsland.

Coast grey box shows a marked preference for better quality soils, especially deep loams over limestone. It will grow on both periodically waterlogged and somewhat dry sites.

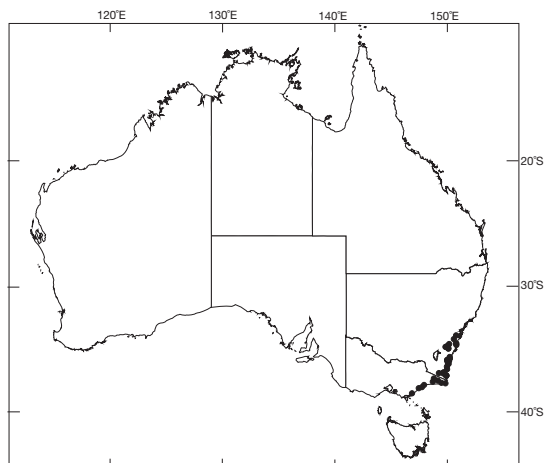
Unlike most other boxes, which are typically woodland trees, this is a tall forest tree. At its best it grows in tall open forests or along small river flats where conditions are favourable for good development. While commonly growing with other eucalypts, it may occasionally be in small pure stands. Associated eucalypts include woollybutt (*E. longifolia*), mountain grey gum (*E. cypellocarpa*), grey ironbark (*E. paniculata*), yellow stringybark (*E. muelleriana*), spotted gum (*E. maculata*), red ironbark (*E. tricarpa*), river peppermint (*E. elata*), white stringybark (*E. globoidea*) and apple-topped box (*E. angophoroides*), and it also occurs with casuarinas (*Allocasuarina* spp.).

Related species: Brooker (2000) placed coast grey box with western white gum (*E. argophloia*) in series *Submelliodorae*. The series is somewhat taxonomically isolated and the two species are widely separate in distribution, *E. argophloia* being a Queensland endemic. Both can be very tall trees and their fruits have 5 or 6 valves. Coast grey box has thin, box-type bark on the lower trunk, and larger buds and fruits than the smooth-barked *E. argophloia*. Coast grey box can be confused with yellow box (*E. melliodora*), which can co-occur. The latter usually has more and thicker rough bark, rounder juvenile leaves, and differs fundamentally in the completely inflexed stamens with outer staminodes that place it in another taxonomic subsection (*Terminales*).

Publication: *Austral. J. Pharm.* 10, 293 (1895). Type: Between the Nicholson and Tambo Rivers, Victoria, C.L. Schlipalius.

Names: Botanical honours J. Bosisto (1824–1898), a manufacturer of essential oils. Common refers to habitat and taxonomic group.

Bark: Usually rough and persistent on the lower part of the trunk at least, light grey, thin, finely fibrous and slightly flaky; or sometimes more or less gum-barked, shedding in long ribbons from the trunk and the branches, leaving a smooth light grey or white surface.



Leaves: Seedling—opposite for a few pairs then alternate, petiolate, ovate to almost orbicular, 4–8.5 × 3–6.5 cm, green, discolorous. Juvenile—alternate, petiolate, ovate to orbicular, 6–10 × 3–9.5 cm, green, discolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate or falcate, 10–20 × 0.7–2 cm, green, concolorous.

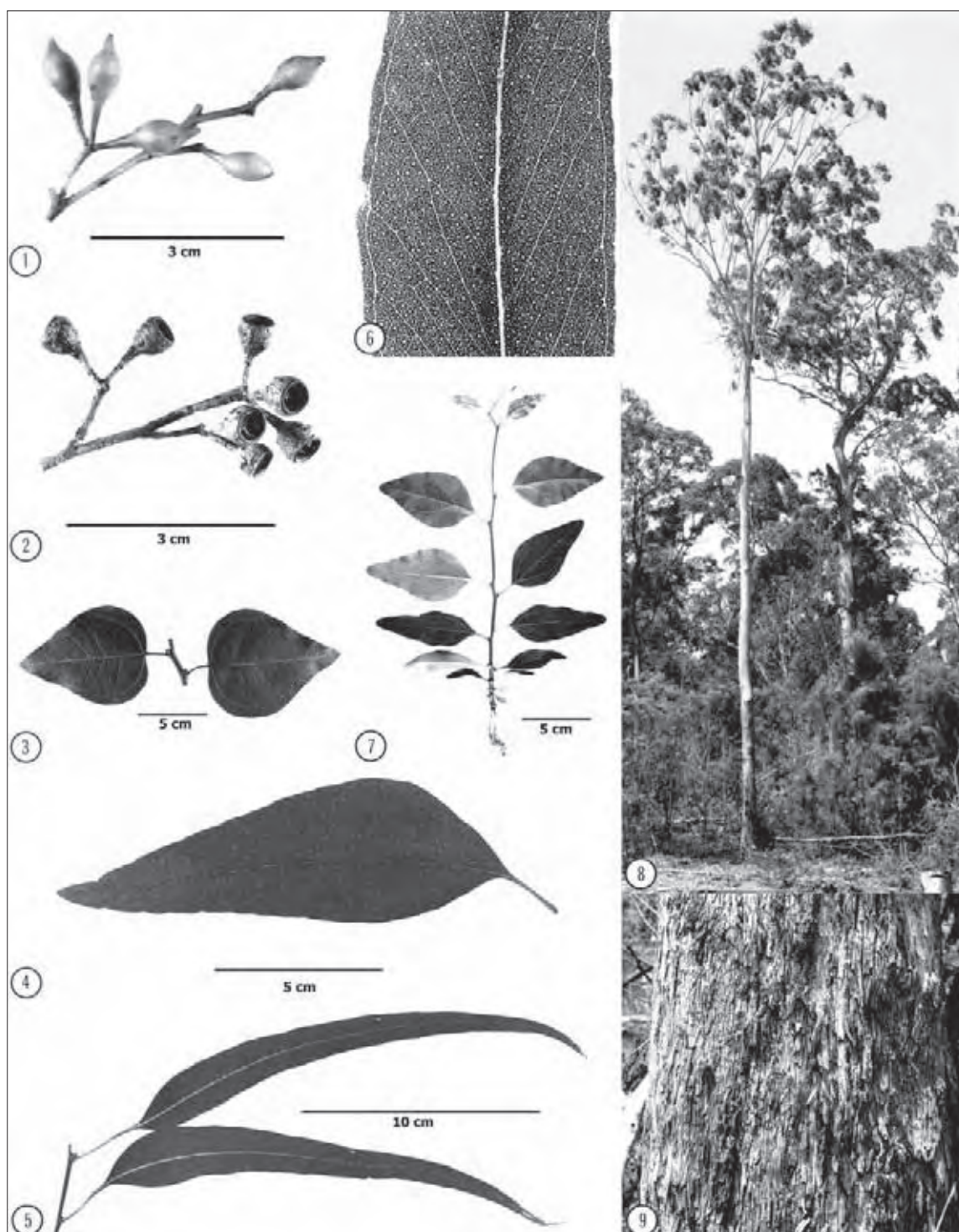
Inflorescences: Mostly simple, axillary 7-flowered inflorescences but with some apparently terminal panicles; peduncles angular, 0.5–1.5 cm long; pedicels angular, 0.3–1 cm long, the angles often continuing as faint ribs along the hypanthia and opercula; buds ovoid or clavate, 0.6–0.9 × 0.3–0.4 cm; opercula conical, beaked or sometimes more or less hemispherical. Flowers Nov.–Feb.

Fruits: Pedicellate, hemispherical, cupular or ovoid, 0.4–0.7 × 0.45–0.7 cm; disc of moderate width, descending; valves usually 5 or 6 (occasionally 4 or 7), enclosed or to rim level. Seeds ovoid or compressed-ovoid, black, brown or grey, hilum ventral.

Wood: Sapwood sometimes damaged by *Lyctus* borers; heartwood light brown with a pinkish tinge, fine-textured, interlocked grain, hard, very strong and extremely durable; density 985–1190 kg m⁻³; used for heavy engineering construction, poles, cross-arms, railway sleepers and fences.

Climate: Altitudinal range: near sea level to 610 m; Hottest/coldest months: 22–28°C/1–6°C; Frost incidence: low to moderate (5–40 each winter at higher elevations); Rainfall: 750–1900 mm per year, uniform.

Distinctive features: Medium-sized to very tall tree with thin, light grey, fibrous bark on part of trunk at least, smooth whitish above; juvenile leaves ovate to orbicular; adult leaves narrow-lanceolate; buds hold the outer opercula until flowering; fruits commonly with 5 or 6 valves.



Eucalyptus bosistoana 1. Buds 2. Fruits 3. Juvenile leaves 4. Intermediate leaf 5. Adult leaves 6. Adult leaf venation 7. Seedling 8. Tree, north-west of Narooma, N.S.W. 9. Bark

Blue-leaved Mallee

Eucalyptus polybractea R.T. Baker

Blue-leaved mallee is a typical multi-stemmed mallee attaining heights of 5–10 m with ash-coloured or somewhat bluish canopies.

Blue-leaved mallee has a restricted natural occurrence in two main disjunct areas separated by about 400 km; it is common in the Wyalong district of New South Wales and in the Bendigo district of central north-western Victoria.

This species grows on the rises and flats of gently undulating country with a small altitudinal range. Soils are commonly red-brown loams often with quartz, while it also occurs in sandy and shale soils.

Blue-leaved mallee grows in tall shrublands. Bull mallee (*E. behriana*), green mallee (*E. viridis*) and Kamarooka mallee (*E. froggattii*) are the common associates in Victoria, while in the Wyalong area it is found with green mallee (*E. viridis*), red ironbark (*E. sideroxylon*), inland grey box (*E. microcarpa*), white mallee (*E. dumosa*), red mallee (*E. socialis*), bull mallee (*E. behriana*) and broombush (*Melaleuca uncinata*).

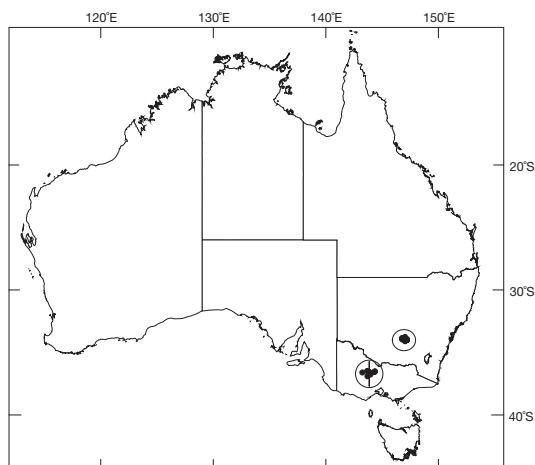
Related species: Brooker (2000) placed blue-leaved mallee in series *Buxaeales* (the southern and eastern boxes), subseries *Continentes*, a relatively large group of both trees and mallees that have buds which do not shed the outer operculum until anthesis. It is related to green mallee (*E. viridis*), which is distinctive in the green, narrower, linear to narrow-lanceolate leaves. Green mallee has a much wider distribution extending north into central Queensland and west to Eyre Peninsula in South Australia. Peppermint box (*E. odorata*) from South Australia and far western Victoria is also similar to blue-leaved mallee but differs in having somewhat larger fruits and greener leaves. In mallee areas blue-leaved mallee might be confused with white mallee (*E. dumosa*), which is unrelated, having versatile anthers, pith glands and flattish, lustrous reddish seeds.

Publication: *Proc. Linn. Soc. N.S.W.* 25, 692 (1901). Type: West Wyalong, New South Wales, Dec. 1900, R.H. Cambage.

Names: Botanical—Greek *poly* (much, many), Latin *bractea* (bract), referring to the bracts around young buds, though not a particularly distinctive feature for this species as young inflorescences in all eucalypts are bracteate. Common—refers to habit and leaf colour.

Bark: Some slightly rough, subpeltate bark may be retained on the lower part of larger stems; otherwise smooth, whitish, salmon pink, orange or grey.

Leaves: Seedling—opposite for a few pairs then alternate, sessile or very shortly petiolate, lanceolate to linear, 3.5–9 × 0.8–2 cm, green or greyish green, concolorous or slightly discolorous. Juvenile—alternate, sessile to very shortly petiolate, lanceolate to linear, 8.5–13.5 × 0.7–2 cm, green or greyish green, concolorous. Intermediate—alternate, petiolate, lanceolate to narrow-lanceolate, 8–12 × 0.9–1.7 cm, green or greyish green, concolorous. Adult—alternate, petiolate, narrow-lanceolate, 6–11 × 0.4–1.1 cm, bluish green or greyish green, concolorous.



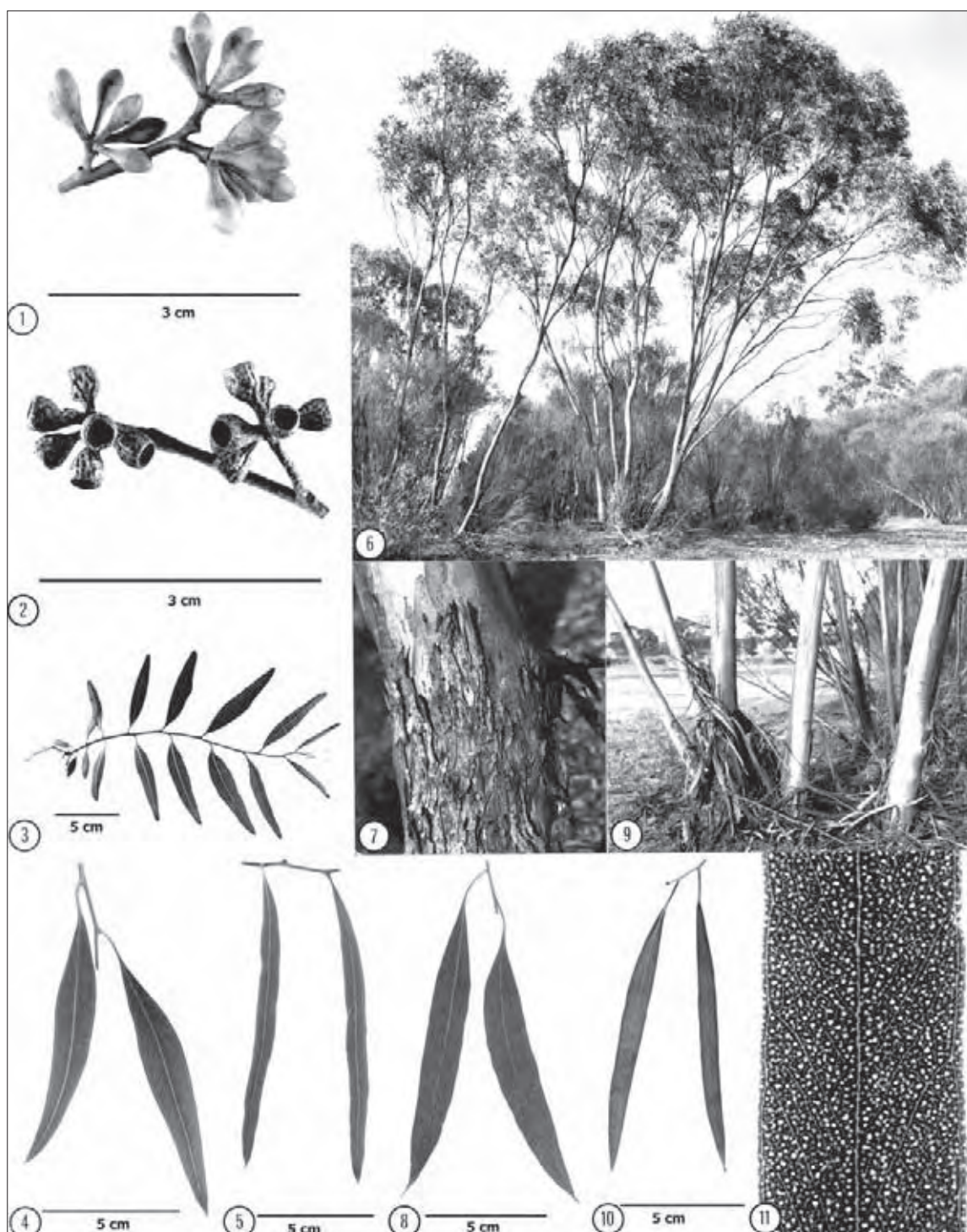
Inflorescences: Simple, axillary, unit inflorescences 7 to 11-flowered, or with some more or less terminal panicles; peduncles terete to slightly angular, 0.4–1.5 cm long; pedicels generally stout, angular, 0.1–0.6 cm long, with angles continuing as fine ribs along hypanthia and opercula; buds more or less clavate, 0.5–0.7 × 0.3–0.4 cm; opercula hemispherical, hemispherical-apiculate or broadly conical. Flowers Mar.–Jun.

Fruits: Pedicellate, truncate-ovoid, cupular or more or less hemispherical, 0.3–0.5 × 0.3–0.5 cm, faintly ribbed at least on lower part of hypanthia; disc relatively broad, steeply descending; valves usually 4, enclosed. Seeds ovoid, grey, brown or black, hilum ventral.

Wood: Hard, strong and tough, density 850 kg m⁻³; formerly used by Aboriginal people to make spear shafts.

Climate: Altitudinal range: 140–360 m; Hottest/coldest months: 29–32°C/2–3°C; Frost incidence: moderate (up to 10 each winter); Rainfall: 450–550 mm per year, uniform and winter max.

Distinctive features: Mallee habit, often in whipstick form; narrow and greyish seedling and juvenile leaves; adult leaves narrow-lanceolate; bluish green or greyish green; all leaves copiously oil-dotted. This species is a valuable oil producer because of the high concentration of cineole in the leaves; production can be up to 110 kg per hectare per year. The species coppices strongly and even after 20 years of repeated cutting to ground level, vigorous new growth comes from the lignotuber.



Eucalyptus polybractea 1. Buds 2. Fruits 3. Seedling 4, 5. Juvenile leaves 6. Mallees, near West Wyalong, N.S.W. 7, 9. Bark 8. Intermediate leaves 10. Adult leaves 11. Adult leaf venation

Green Mallee

Eucalyptus viridis R. T. Baker

Green mallee varies in height from 4–8 m with stem diameters from 6–18 cm. It grows mainly in mallee form and only occasionally develops as a small tree. The canopy tends to be rather light and, especially in the case of the taller growth, is carried on the upper third of the height. There are two subspecies, the typical and subsp. *wimmerensis*.

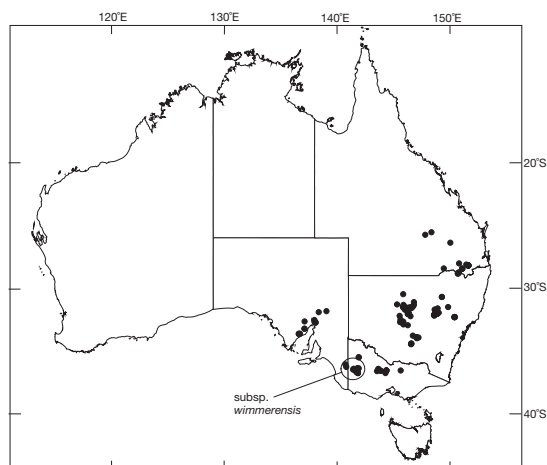
Typical green mallee has a widespread and scattered distribution in south-eastern Australia, from north-west of Taroom in Queensland, through mid-western New South Wales, particularly around Wyalong and south to the Benalla and Bendigo area in northern Victoria and west in the Little Desert. In South Australia there are small occurrences in high country, including the Cleve Hills of central-eastern Eyre Peninsula, and the Flinders Ranges, north of Adelaide. Subsp. *wimmerensis* is restricted to western Victoria and the Bordertown region of South Australia.

Green mallee grows on plains and gentle undulating topography where it usually occurs on relatively heavy, loamy or clay soils, often with stony surfaces. Other soils may be sands or sandy loams with some clay in the subsoil. On some sites there may be limited surface drainage. It also occurs on tops of lateritic mesas in central south-eastern Queensland.

Like most mallees this species occurs in tall shrublands and tends to grow either in fairly dense, pure stands or in mixtures mainly with other mallee species, such as blue mallee (*E. polybractea*) and mallee bull (*E. behriana*). Tree form eucalypts mainly include species of the box and red gum groups and, in Victoria, red ironbark (*E. sideroxylon*). In South Australia it is associated with other mallees (*E. oleosa*, *E. gracilis*).

Related species: Brooker (2000) placed green mallee in series *Buxales* (the southern and eastern boxes), subseries *Continentes*, a relatively large group of both trees and mallees that have buds which do not shed the outer operculum until anthesis. Green mallee is close to several other mallee box species, viz. blue mallee (*E. polybractea*), which may be associated with it and which differs by the broader pruinose or bluish leaves, peppermint box (*E. odorata*), which occurs almost exclusively in South Australia and which differs by the broader (green) leaves, and mostly axillary inflorescences, and purple-bowered mallee (*E. albopurpurea*) of southern Eyre Peninsula and Kangaroo Island of South Australia, which has broader leaves and often purple flowers. Two species in New South Wales have slight distinctions from green mallee, viz. *E. aenea* Hill (1997) restricted to the Goulburn River National Park, which differs by the broader adult and juvenile leaves, and *E. castrensis* Hill (2002), which differs by the longer, broader adult leaves, the broader juvenile leaves and larger buds.

Publication: Subsp. *viridis*: *Proc. Linn. Soc. New South Wales* 25, 316 (1900). Type: Girilambone, N.S.W., 16 Jan. 1900, W. Bauerlen. Subsp. *wimmerensis* (Rule) Brooker & Slee: *Muelleria* 9, 81 (1996). Type: Lawloit Range on the Western Highway between Nhill and Kaniva, Victoria, 27 Dec. 1964, J.H. Willis.



Names: Both refer to the green colour of the leaves (Latin *viridis*, green).

Bark: Rough box-type, tight, hard, grey on lower half of stems or trunk with branches smooth grey, white or pinkish grey (*viridis*), mostly smooth (*wimmerensis*).

Leaves: Seedling: Opposite for 3–6 pairs then alternate, very shortly petiolate, linear to narrow-lanceolate, 6–15 × 0.2–1 cm (*viridis*), lanceolate, 6–11 × 0.6–2.5 cm (*wimmerensis*), dull, green to bluish green. Juvenile: Opposite for few pairs then alternate, very shortly petiolate, linear, 5.5–9.5 × 0.3–0.5 cm (*viridis*), narrow-lanceolate to narrowly elliptical, 4.5–9.5 × 0.4–1 cm (*wimmerensis*), bluish green to green, concolorous; oil dots profuse. Adult: Alternate, shortly petiolate, linear to narrow-lanceolate, often held more or less erect, 6–10 × 0.3–0.8 cm, slightly glossy, dark green (*viridis*), narrow-lanceolate, erect, 5–10.5 × 0.4–1.5 cm, slightly glossy, green to bluish green, concolorous (*wimmerensis*); side veins acute, oil dots plentiful. The leaves are important in the essential oil industry; cineole content may be as high as 80 per cent.

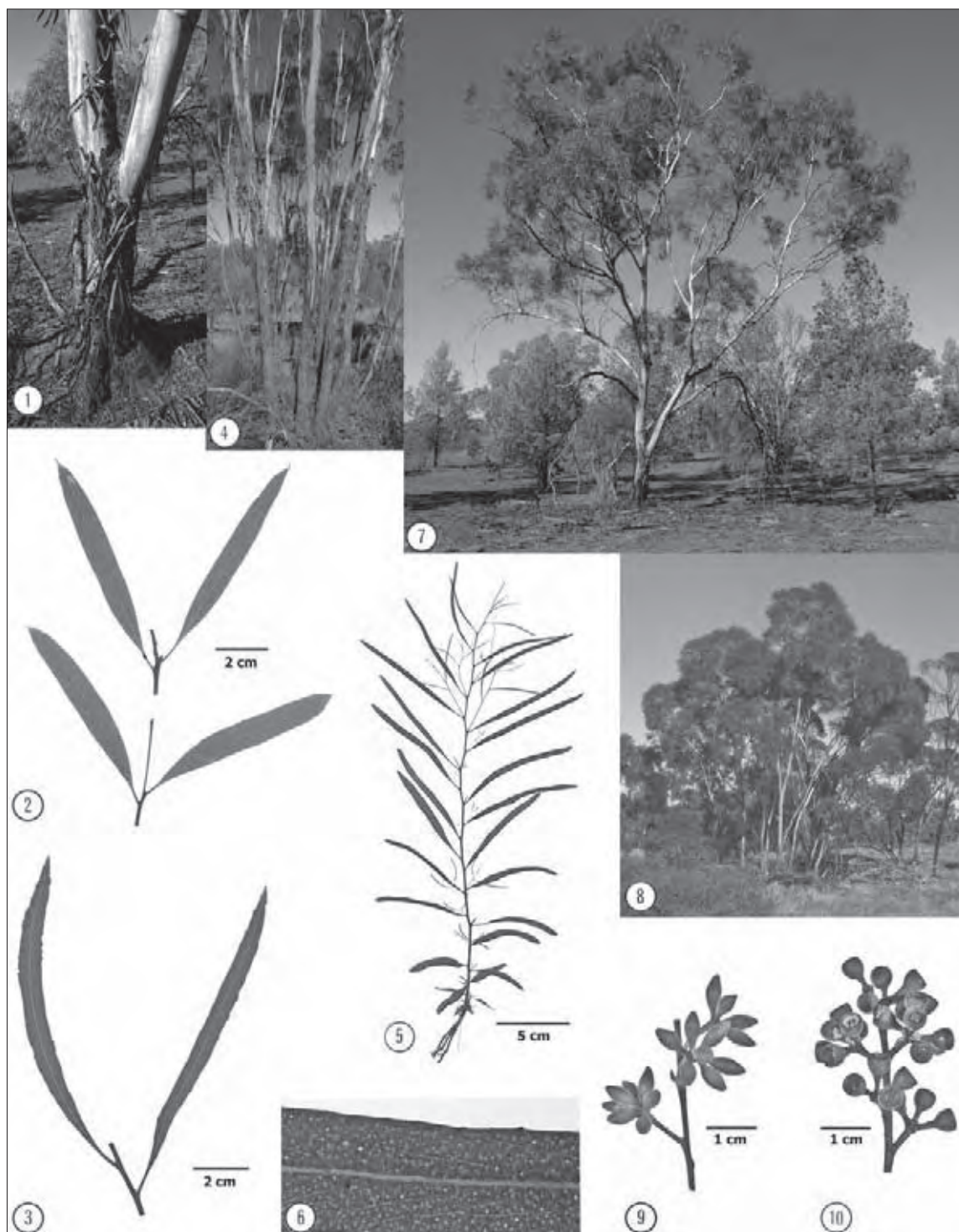
Inflorescences: Terminal panicles or axillary umbels, 7 or 9(11)-flowered; peduncles, 0.3–1.3 cm long; pedicellate; buds ovoid to broadly fusiform, c. 0.7 × 0.3 cm; opercula conical, as long as wide. Flowers Nov.–Jan.

Fruits: Pedicellate, cupular, c. 0.5 × 0.6 cm; disc descending; valves 3 or 4, to rim level or enclosed. Seeds ovoid, blackish, brown or grey, hilum ventral.

Wood: Hard, yellow colour, close-grained, density probably around 850 kg m⁻³ and very similar to blue mallee (*E. polybractea*); mature lignotubers are excellent Prewood.

Climate: Altitudinal range: 150–500 (–900) m; Hottest/coldest months: 29–34°C/1–3°C; Frost incidence: moderate; Rainfall: 330–660 mm per year, winter max., uniform, summer max.

Distinctive features: Mallee or small tree; bark rough, hard, grey, on lower part of stems or trunk (*viridis*) or mostly smooth (*wimmerensis*); leaves linear, green (*viridis*) or broader, green to bluish green (*wimmerensis*); inflorescences terminal and axillary; small fruit with narrow rim and small valves.



Eucalyptus viridis 1, 4. Bark 2. Juvenile leaves 3. Adult leaves 5. Seedling 6. Adult leaf venation 7. Tree, near Cobar, N.S.W. 8. Mallee, near West Wyalong, N.S.W. 9. Buds 10. Fruits

■ The Box-ironbarks

Eucalyptus series *Siderophloiae* Blakely

This is a group of about 13 species distributed principally in Queensland and north-eastern New South Wales outside the truly arid regions. One species, Wandii ironbark (*E. jensenii*), is of northern and north-western distribution and is found in the Top End of the Northern Territory and in the Kimberley region of Western Australia and south to the Edgar Range. The most southerly distribution is that of broad-leaved red ironbark (*E. fibrosa* subsp. *fibrosa* which occurs as far south as the Moruya State Forest on the South Coast of New South Wales. Silver-leaved ironbark (*E. melanophloia*) has the widest habitat distribution and occurs from the north-west of New South Wales to northern Queensland and includes such diverse habitats as the high country of the Consuelo Tableland and the Brisbane region.

The group is widely distributed on the plains and slopes west of the Great Dividing Range where the species occur usually in woodlands often associated with box and bloodwood species. Towards the east coast where the rainfall is higher, they are more often found in open forest. Usually they are small to medium-sized trees although gum-top ironbark (*E. decorticans*), the tallest species of the group, can reach heights of 40 m.

The timber is dark red, hard strong and durable and the better-formed trees can be used for heavy construction, poles, railway sleepers and piles. One species, lemon-scented ironbark (*E. staigeriana*) of Cape York Peninsula is notable for its production of the lemon-scented aldehyde, citral. Species such as the silver-leaved ironbarks *E. melanophloia* and *E. shirleyi* have some ornamental potential while narrow-leaved red ironbark (*E. crebra*) is sometimes planted because of its narrow foliage.

Botany

The series *Siderophloiae* is a large, distinctive group of ironbarks in section *Adnataria*, although this term is deceptive. All have deeply furrowed bark, which is very hard in most species but is notably flaky in many populations of *E. fibrosa* subsp. *fibrosa*. Most species are completely rough-barked except *E. decorticans* which has strikingly smooth, white-barked upper branches.

Two species, the silver-leaved ironbarks (*E. melanophloia* and *E. shirleyi*) are reproductively mature when the canopy is in the juvenile leaf phase. These leaves are conspicuously grey or bluish grey. In the other species adult leaves are always produced and the greatest contrast is between the narrow-lanceolate leaves of *E. crebra* and *E. exilipes* and the broad-lanceolate leaves of *E. fibrosa*.

The series *Siderophloiae* differs in floral characters from the other ironbarks, namely the series *Rhodoxylon* and the two red ironbarks (*E. sideroxylon* and *E. tricarpa*). In the bud, staminal filaments in series *Siderophloiae* are flexuose and all are fertile. In the other ironbarks the staminal filaments are completely inflexed and the outer ones are barren.

Fruit shape is somewhat variable: obconical in *E. fibrosa*, truncate-globose to cupular in *E. crebra* and *E. melanophloia* while the square (in section) fruits of Pentland ironbark (*E. quadricostata*) and the pruinose *E. farinosa* are probably the most distinctive in the series. The disc of the fruits in most species is descending and inconspicuous, though it tends to be more prominent in the broad-leaved red ironbarks (*E. fibrosa* and *E. siderophloia*), and in Cullen's ironbark (*E. cullenii*) it is a broad annular ring surrounding the valves.

Many ironbark species of the *Siderophloiae* have been discovered and published in the last 20 years. Of these, we include *E. exilipes* in this edition because of its extreme morphological characters for the group, i.e. linear leaves and delicate buds and fruits.



Over its extensive natural distribution narrow-leaved red ironbark (*E. crebra*) occurs in a wide range of habitats and is one of the most morphologically variable species in the box-ironbark group. 1. A large pure stand, Valley of the Lagoons Station, Qld. 2, 3. Mature and maturing stands at Leard State Forest near Boggabri, N.S.W. 4. A remnant tree on agricultural land near Muswellbrook, N.S.W.

Broad-leaved Red Ironbark Broad-leaved Ironbark, Blue-leaved Ironbark

Eucalyptus fibrosa F. Muell.

Broad-leaved red ironbark is a medium-sized to tall tree, 15–35 m in height and up to 1.5 m dbh. Stems are generally straight and to about half the tree height. There are two subspecies, the typical and subsp. *nubila*.

Subspecies *fibrosa* extends from the vicinity of Moruya on the South Coast of New South Wales to north-west of Rockhampton in Queensland, a distance of some 1500 km. Subspecies *nubila* occurs in two disjunct areas, separated by some 200 km, both partially overlapping the distribution of subsp. *fibrosa*. The larger of these areas starts north of Glen Innes in New South Wales and extends north and north-west to an area south of Springsure in Queensland. The other occurrence extends westward from around Muswellbrook towards the Dubbo and Gilgandra areas in New South Wales. The distribution of subsp. *nubila* is always west of the more coastal subsp. *fibrosa*.

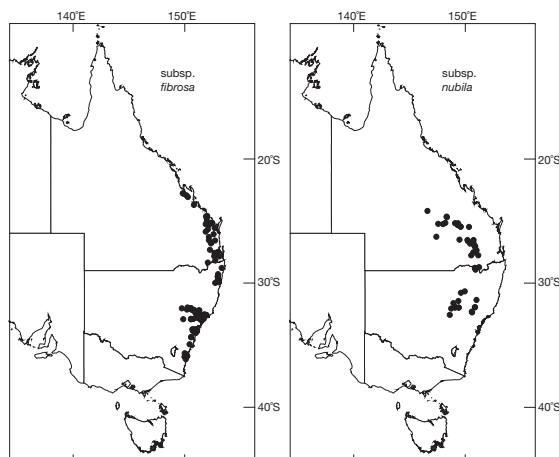
Soil types are varied, ranging from relatively poor sandstone sites to fair quality loams and clay loams.

Both subspecies occur mainly in open forests. Species associated with subsp. *fibrosa* include spotted gums (*E. maculata*, *E. citriodora* subsp. *variegata*), white mahogany (*E. umbra*), Beyer's ironbark (*E. beyeri*), white stringybark (*E. globoides*), grey ironbark (*E. paniculata*), red ironbarks (*E. crebra* and *E. sideroxylon*), and with subsp. *nubila* include the bloodwoods *E. citriodora* subsp. *variegata* and *E. trachyphloia*, large-fruited yellowjacket (*E. watsoniana*), narrow-leaved grey box (*E. pilligaensis*), narrow-leaved white mahogany (*E. tenuipes*) and cypress pines (*Callitris* spp.).

Related species: In the past, there has been confusion regarding the status of this species. In the first edition of *Forest Trees of Australia* (1957) broad-leaved red ironbark was regarded as the same as coast ironbark (*E. siderophloia*). This was corrected in the 1970 edition, when the two species were recognised as distinct. Brooker (2000) placed broad-leaved red ironbark in the series *Siderophloiae* in the now large subseries *Subglaucæ*. The subseries comprises about twenty species, many of which have been discovered and published since 1984. Broad-leaved red ironbark is probably most closely related to coast ironbark (*E. siderophloia*), which differs in the smaller leaves, buds and fruits. Serpentine ironbark (*E. ophitica*), recognised by Johnson and Hill (1990), has affinities to broad-leaved red ironbark, but differs in having smaller buds with rounded opercula, fruit with scarcely exerted valves and occurring only on serpentine substrates.

Publication: *E. fibrosa*: J. Linn. Soc. Bot. 3, 87 (1859). Type: Near the Brisbane River, Queensland, F. von Mueller. Subsp. *nubila* (Maiden & Blakely) L.A.S. Johnson: *Contr. N.S.W. Natl Herb.* 3, 119 (1962). Types: Dubbo district, New South Wales, Nov. 1897, J.V. de Couque & J.L. Boorman; Dubbo district, New South Wales, Nov. 1892, H. Deane.

Names: Botanical Latin *fibrosus* (Pbrous, composed of separable threads of Pbres), refers to the bark; Latin *nubilus* (cloudy, dark, greyish blue), presumably in reference to the bluish leaves. Common refer to the leaves and to the bark.



Bark: Ironbark, typical in appearance but varying from soft to hard, often baky, moderately to deeply longitudinally furrowed, greyish black to black, persistent to small branches.

Leaves: Seedling Opposite for about 4 pairs then alternate, petiolate, ovate to orbicular, 4–10 × 2–6 cm, green to greyish green, slightly discolorous (*fibrosa*); greyish blue and concolorous (*nubila*). Juvenile Alternate, petiolate, ovate to orbicular, 11–17 × 5–10 cm, colour similar to seedling stage. Intermediate Alternate, petiolate, broad-lanceolate, 15–18 × 2.5–5 cm, green (*fibrosa*) or greyish green (*nubila*), concolorous. Adult Alternate, petiolate, lanceolate, 8–15 × 1.5–2.5 cm, greyish green, concolorous.

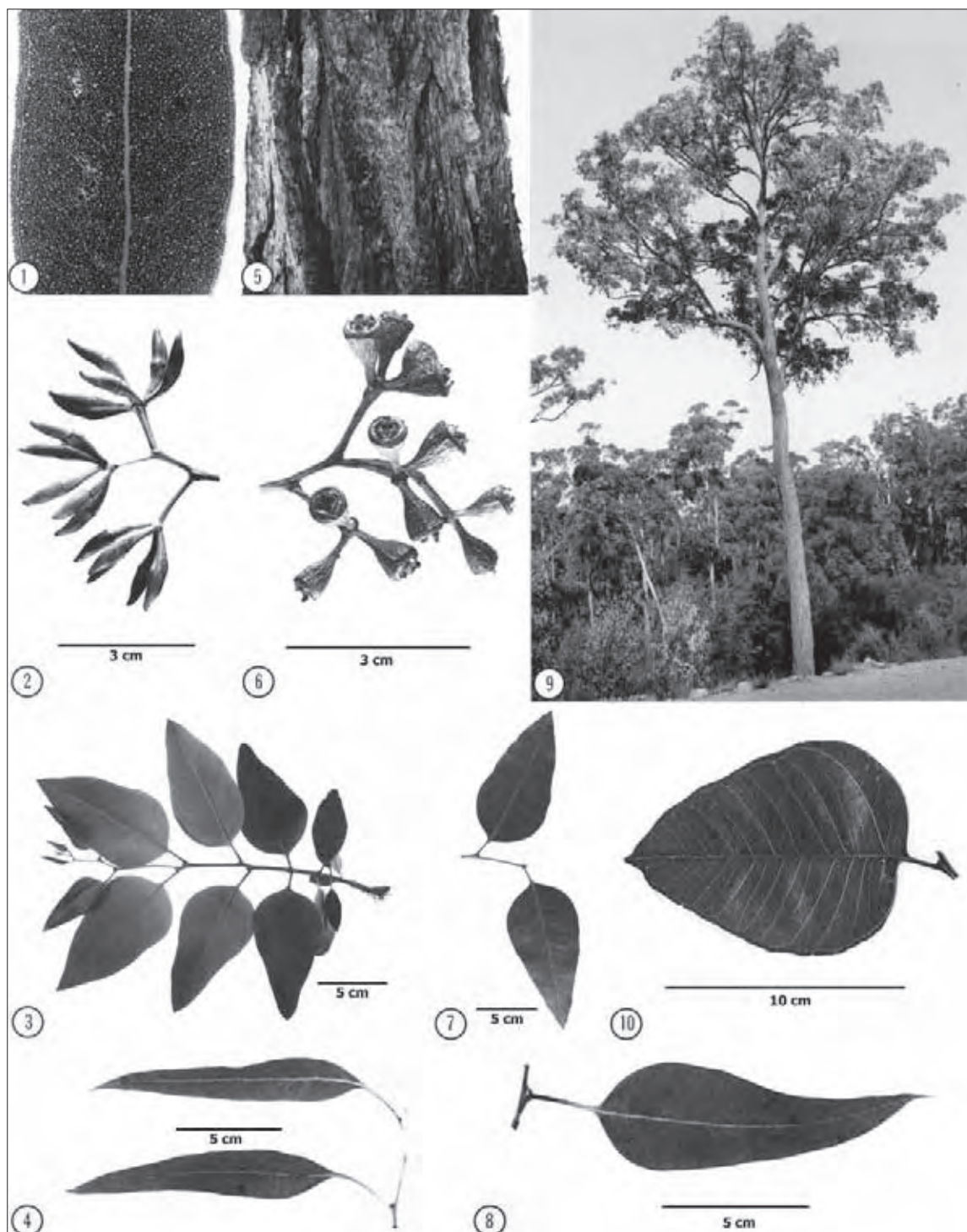
Inflorescences: Generally terminal panicles, with some simple, axillary inflorescences which are 7 to 11-flowered; peduncles more or less terete to slightly flattened, 0.5–2 cm long; pedicels angular, 0.2–1 cm long, angles continuing as ribs along hypanthia; buds elongated, double-conic, 1.2–2.5 × 0.3–0.5 cm, pruinose (*nubila*) or non-pruinose (*fibrosa*); opercula conical or horn-shaped. Flowers Nov.–Feb.

Fruits: Pedicellate, obconical rarely more or less hemispherical, 0.5–1.2 × 0.4–1 cm, sometimes slightly ribbed; disc level to ascending; valves 4 or 5 varying from around rim level to exerted; some pruinose in subsp. *nubila*. Seeds ovoid to compressed-ovoid, grey-brown, hilum ventral.

Wood: Sapwood yellowish, relatively resistant to attack by *Lyctus* borers; heartwood light to dark red-brown, pnetextured, grain usually interlocked and wavy, hard, strong, extremely durable and termite resistant; density 1035–1195 kg m⁻³, used for heavy engineering construction, poles and railway sleepers and high-wearing flooring.

Climate: Altitudinal range: 20–700 m (*fibrosa*), 180–700 m (*nubila*); Hottest/coldest months: 24–33°C/1–7°C (*fibrosa*), 28–33°C/2–5°C (*nubila*); Frost incidence: low to moderate, with up to 30 each winter at inland sites (*fibrosa*, *nubila*); Rainfall: 620–1230 mm per year (*fibrosa*), 580–800 mm per year (*nubila*), uniform and summer max.

Distinctive features: Medium-sized to tall ironbark trees of reasonable stem form with ovate to orbicular juvenile leaves; subsp. *nubila* has pruinose branchlets and inflorescences, and greyish blue juvenile leaves; elongated, conical or horn-shaped opercula.



Eucalyptus fibrosa: subsp. *fibrosa* (f), subsp. *nubila* (n) 1. Adult leaf venation (f) 2. Buds (n) 3. Seedling (n) 4. Adult leaves (f) 5. Bark (f) 6. Fruits (f) 7, 10. Juvenile leaves (f) 8. Intermediate leaf (n) 9. Tree, west of Moruya, N.S.W. (f)

Coast Ironbark Grey Ironbark

Eucalyptus siderophloia Benth.

Coast ironbark is a medium-sized or tall tree 20–45 m tall with a dbh to 75 cm or sometimes greater. It is usually an erect tree of good form, branching at above half tree height to form a crown of green to slightly grey-green leaves.

This ironbark species is distributed along the east coast and nearby foothills of the continent, from the Hawkesbury River region north of Sydney as far as Bundaberg in south-eastern Queensland. In Queensland, coast ironbark occurs also on Fraser Island and its westernmost occurrences are near Yarraman in the south and near Many Peaks in the north.

Coast ironbark grows mainly on the foothills, hill-sides and slopes of coastal and subcoastal ranges. It occurs on a range of substrates including clays, loams and sands derived from shale, sandstone, conglomerate, granite or laterite.

This species occurs in open and tall open forests and there are many associated tree species. These include forest red gum (*E. tereticornis*), spotted gums (e.g. *E. maculata*, *E. henryi*), broad-leaved red ironbark (*E. fibrosa*), tallow-wood (*E. microcorys*), grey gum (*E. propinqua*), white mahoganies (*E. acmenoides*, *E. umbra*), grey box (*E. moluccana*) and *Lophostemon* spp.

Related species: The ironbarks consist of many species, which divide into two groups diagnosed by having buds with inflexed or irregularly flexed stamens. Coast ironbark belongs to a large group of species in the latter group (subsection *Apicales*) in series *Siderophloiae*, which consists of about 20 species (Brooker 2000). Some of these species are widespread, and may be confused with coast ironbark, particularly narrow-leaved red ironbark (*E. crebra*), which differs in having narrower leaves and relatively delicate buds and fruits. Broad-leaved red ironbark (*E. fibrosa*) is also closely related but is distinguished by the broader leaves and much larger buds and fruits. Both these related species occur within the distribution of *E. siderophloia* and to the north and south of it.

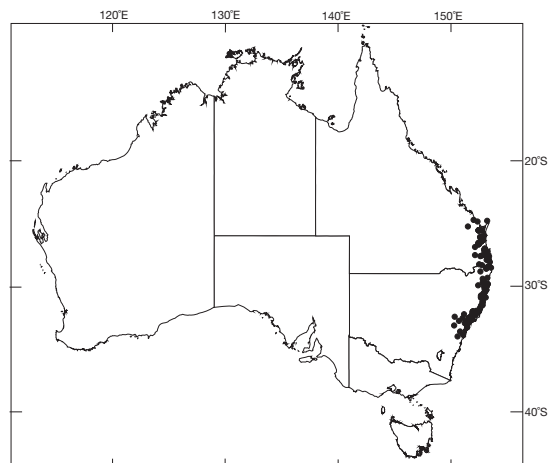
Publication: *Fl. Austral.* 3, 220 (1867). Type: Moreton Bay, Queensland, Sep. 1829, A. Cunningham 51.

Names: Botanical—Greek *sideros* (iron), *phloios* (bark) referring to the hard bark. Common—Alludes to its preference for coastal and subcoastal sites and to its bark type.

Bark: Ironbark, persistent to the small branches, hard, ridged and deeply furrowed, densely impregnated with kino, dark grey or grey-black.

Leaves: Seedling—Opposite for 4 or 5 pairs, petiolate, broad-lanceolate, 5.5–12 × 1.5–5 cm, slightly glossy, dark green, discolorous. Juvenile—Alternate, petiolate, ovate to broad-lanceolate to lanceolate, 5–12 × 1.5–4 cm, green, discolorous. Intermediate—Alternate, petiolate, ovate to broad lanceolate, c. 12 × 4 cm, dull green, discolorous. Adult—Alternate, petiolate, broad-lanceolate to lanceolate, 8.5–17 × 1.5–2.5 cm, dull green to grey-green, concolorous.

Inflorescences: Terminal and some axillary panicles, 7-flowered; peduncles angular, 0.5–1.2 cm long; buds



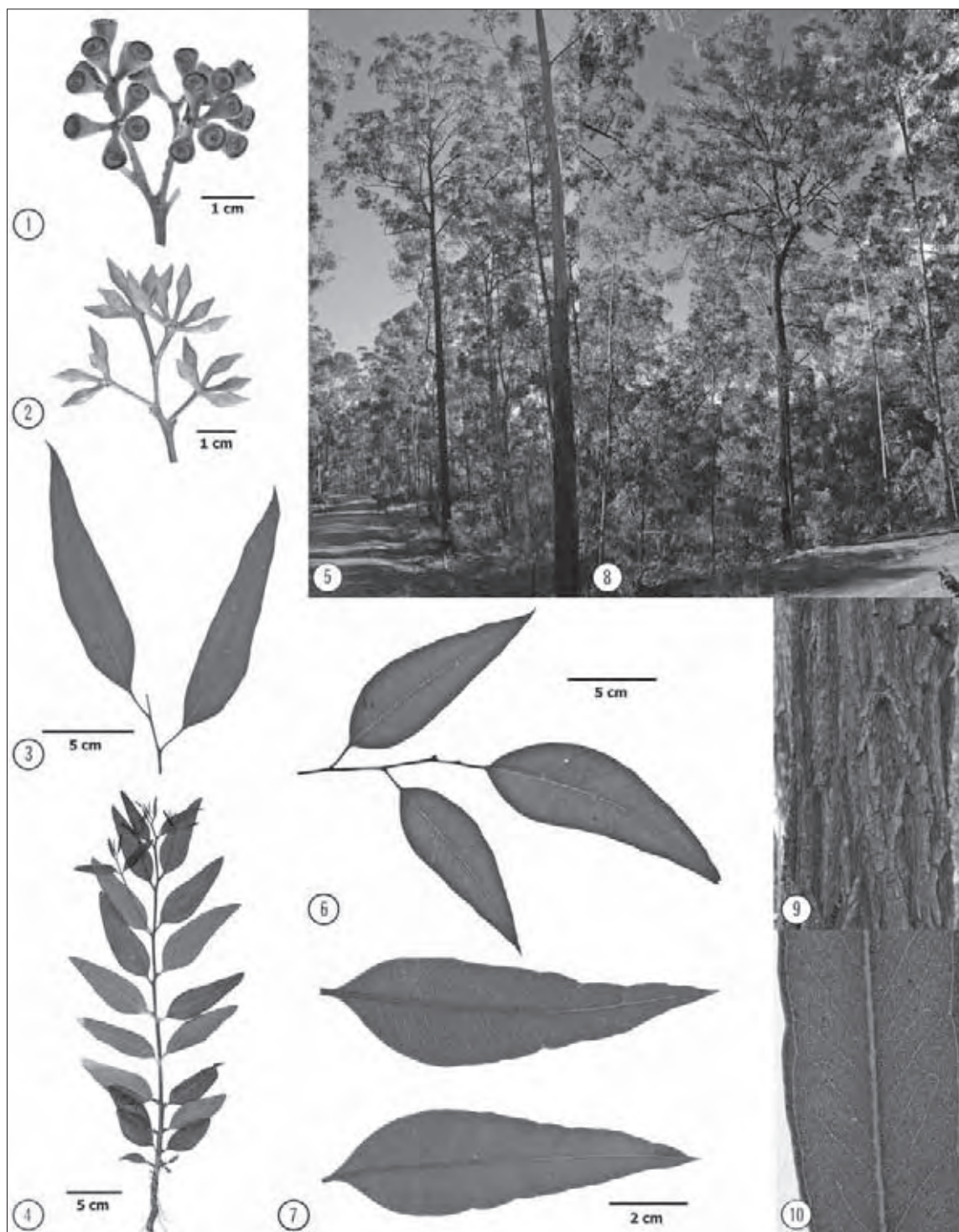
pedicellate, diamond-shaped or broadly fusiform, c. 0.8 × 0.4 cm; opercula conical or slightly beaked. Flowers Jun.–Jan.

Fruits: Pedicellate, obconical, c. 0.8 × 0.7 cm; disc descending; valves 3 or 4, to rim level or slightly exserted. Seeds compressed-ovoid, brown, hilum ventral.

Wood: Sapwood pale red, not susceptible to *Lyctus* borers, heartwood red to red-brown, with an interlocking grain; density 1035–1200 kg m⁻³; uses include scantling, poles, railway sleepers, bridge building and flooring. Wood almost identical to broad-leaved red ironbark (*E. fibrosa*).

Climate: Altitudinal range: near sea level to 580 m; Hottest/coldest months: 25–30°C/2–10°C; Frost incidence: low to moderate (inland sites); Rainfall: 850–1800 mm per year, mainly summer max.

Distinctive features: Medium-sized to tall, erect tree, with dark grey ironbark to the small branches; inflorescences mostly terminal panicles; fruits obconical.



Eucalyptus siderophloia 1. Fruits 2. Buds 3. Adult leaves 4. Seedling 5, 8. Trees, Collumbatti State Forest, Qld
6. Intermediate leaves 7. Juvenile leaves 9. Bark 10. Adult leaf venation

Gum-top Ironbark

Eucalyptus decorticans Maiden

Gum-top ironbark is a medium-sized to tall tree attaining heights of up to 40 m and dbh to 1.2 m on soils of comparatively low fertility. The trunk is generally straight and may be unbranched for half or more of the tree height. Canopy branches are notably smooth.

Gum-top ironbark is confined to an area of south-eastern Queensland, about 650 km long and 300 km wide immediately south of the Tropic of Capricorn, from east of Blackall east to Monto and south-east almost to Toowoomba. It also occurs on the Callide Range north of Biloela.

This eucalypt favours very stony soils, most commonly sandstone areas and is generally on hilly topography.

Gum-top ironbark occurs in open forests. Commonly associated tree species include narrow-leaved red ironbark (*E. crebra*), lemon-scented gum (*E. citriodora*), Gympie messmate (*E. cloeziana*), brown bloodwood (*E. trachyphloia*), Queensland peppermint (*E. exserta*), broad-leaved red ironbark (*E. fibrosa*) and yellowjacket (*E. bloxsomei*).

Related species: Brooker (2000) followed Blakely (1934) and placed gum-top ironbark in the series *Siderophloiae* in the now large subseries *Subglaucae* (only four species were included in 1934). The subseries comprises about twenty species, many of which have been discovered and published since 1984. Gum-top ironbark is distinct from all other species in the group with its conspicuous smooth-barked branches and hilly habitat, making it easy to distinguish in the field. Two other ironbarks silver-leaved ironbark (*E. melanophloia*) and red ironbark (*E. sideroxylon*) have varying amounts of smooth upper bark and can be found in parts of the same general area as gum-top ironbark. The latter species is diagnosed by having buds with inflexed stamens, whereas gum-top ironbark and *E. melanophloia* have irregularly flexed stamens.

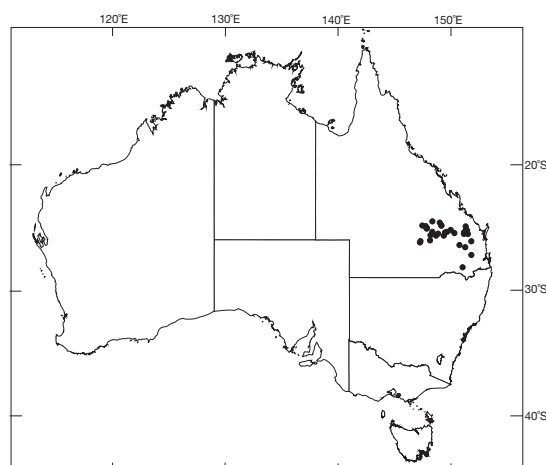
Publication: As *E. siderophloia* forma *decorticans* in *Qld Agric. J.* 26, 127 (1911); then *E. decorticans* in *Crit. Rev. Gen. Euc.* 5, 231 (1922), based on a description in *J. Proc. Roy. Soc. N.S.W.* 47, 80 (1913). Type: Eidsvold district, Queensland, Dr T.L. Bancroft.

Names: Botanical Latin, *decorticans* (with bark peeling off), referring to the smooth crown branches. Common name refers to the smooth crown branches and the characteristic rough bark of this group that typifies the trunk.

Bark: Dark grey to black, deeply fissured longitudinally, persistent on the trunk and larger limbs, then smooth, cream or white.

Leaves: Seedling opposite for a few pairs then alternate, petiolate, lanceolate, 4.5–11 × 1–1.7 cm, green, discolorous. Juvenile alternate, petiolate, lanceolate, 10–14 × 1.6–2.2 cm, green, discolorous. Intermediate alternate, petiolate, narrow-lanceolate, 12–15 × 1.5–2.3 cm, green, concolorous. Adult alternate, petiolate, narrow-lanceolate, 8.5–12 × 1–1.5 cm, green, concolorous.

Inflorescences: Simple, axillary, unit inflorescences 7-flowered or both axillary and terminal panicles; peduncles angular to slightly flattened, 0.5–1.8 cm long; pedicels



generally stout, angular, 0.2–0.6 cm long, with ribs continuing along hypanthia from the angular pedicels; buds double conic to clavate, 0.6–0.7 × 0.3–0.4 cm; opercula conical or more or less hemispherical-apiculate. Flowers Dec.–Jan.

Fruits: Pedicellate, truncate-ovoid to occasionally almost hemispherical, sometimes faintly ribbed, 0.4–0.7 × 0.4–0.7 cm; disc of medium width, more or less level to slightly ascending, often convex; valves usually 4, varying from slightly below rim level to slightly exserted. Seeds ovoid to compressed-ovoid, grey-brown, hilum ventral.

Wood: Sapwood pale, not susceptible to *Lyctus* borer attack. Heartwood brown to dull reddish brown, hard, very strong, fairly straight-grained, very durable, resistant to termite attack; density around 1040 kg m⁻³; used for heavy engineering construction, railway sleepers and poles.

Climate: Altitudinal range: 200–750 m; Hottest/coldest months: 29–33°C/2–5°C; Frost incidence: low to moderate (up to 20 each winter at high elevations); Rainfall: 625–900 mm per year, summer max.

Distinctive features: An ironbark tree commonly found on relatively dry, sandstone sites; upper limbs smooth and whitish; narrow-lanceolate adult leaves.



Eucalyptus decorticans 1. Adult leaves 2. Intermediate leaf 3. Seedling 4. Juvenile leaf 5. Buds 6. Fruits 7. Tree, near Eidsvold, Qld 8. Bark 9. Adult leaf venation

Narrow-leaved Red Ironbark Ironbark, Narrow-leaved Ironbark

Eucalyptus crebra F. Muell.

Narrow-leaved red ironbark is mostly a medium-sized tree, often attaining 25 m in height and 0.7 m dbh. Under the most favourable conditions it may attain 35 m in height and 1.5 m dbh, with a trunk of good form and up to two-thirds of the tree height. The crown is fairly open and rather straggly.

This species has the widest north-south distribution of any ironbark, extending from north of Cooktown on Cape York Peninsula in Queensland to south of Sydney, New South Wales. It is one of the common trees in a 300 to nearly 500 km wide belt in Queensland reaching from the coast to just beyond the Great Dividing Range where it occurs as far west as Einasleigh, Jericho and Morven. In New South Wales a principal occurrence is in the Baradine area, which is located on the edge of the western plains about 350 km from the sea.

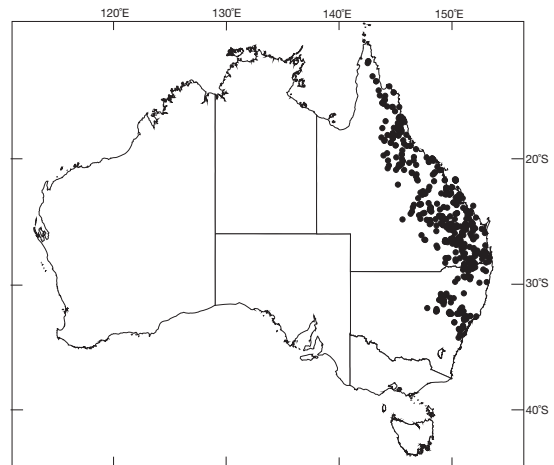
It commonly occurs on country of low relief on undulating plains and low plateaux. In the areas of higher rainfall it is usually found on ridges and higher slopes. It grows on a wide variety of soils including sands, sandy loams and clay loams. Sandstone and granite are both common parent materials.

On typical dry, inland sites, narrow-leaved red ironbark grows in woodlands. It may sometimes be a dominant species, but is commonly in mixture with cypress pines (*Callitris* spp.), belah (*Casuarina cristata*), bull oak (*Allocasuarina luehmannii*), brigalow (*Acacia harpophylla*), apples (*Angophora costata*, *A. floribunda*), carbeen (*E. tessellaris*), bloodwoods (*E. citriodora*, *E. maculata*, *E. clarksoniana*, *E. trachyphloia*), red gums (*E. tereticornis*, *E. dealbata*), grey gums (*E. propinqua*, *E. punctata*), grey boxes (*E. moluccana*, *E. microcarpa*) and other ironbarks (*E. melanophloia*, *E. fibrosa*).

Related species: Brooker (2000) followed Blakely (1934) and placed narrow-leaved red ironbark in the series *Siderophloiae* in the now large subseries *Subglaucæ*. The subseries comprises about 20 species, many of which have been discovered and published since 1984. Narrow-leaved red ironbark is a notoriously variable species. Its narrow adult leaves distinguishes it from most other ironbarks, however, it may be confused with slender-leaved ironbark (*E. exilipes*) of the Pentland district of northern Queensland which differs by the narrower leaves at all stages and the delicate pedicels, buds and fruits. The fruits of narrow-leaved red ironbark are mostly hemispherical to cupular which distinguish it from Bean's ironbark (*E. beaniana*), which is restricted to Isla Gorge in Queensland and has obconical fruits. In the Pilliga Scrub and around Camden, narrow-leaved red ironbark occurs near and closely resembles Beyer's ironbark (*E. beyeri*), which belongs in another taxonomic group distinguished by the inflexed staminal filaments.

Publication: *J. Linn. Soc. Bot.* 3, 87 (1859). Type: Burdekin River, Queensland, 10 Nov. 1856, F. von Mueller.

Names: Botanical Latin *creber* (crowded, frequent), perhaps in allusion to its abundance. Common refers to adult leaves, wood colour and bark type.



Bark: Ironbark, persistent to the small branches, hard, ridged and often deeply furrowed, and densely impregnated with kino, light to dark grey or black.

Leaves: Seedling Opposite for a few pairs then alternate, petiolate, variable in width from broad-lanceolate to linear, 5.1–12.5 × 0.4–2.5 cm, green or greyish green, slightly discolorous. Juvenile Alternate, petiolate, broad-lanceolate, lanceolate or linear, 7–12.5 × 0.7–2.8 cm, green or greyish green, concolorous. Intermediate Alternate, petiolate, lanceolate to broad-lanceolate, 10–17.5 × 1.2–2.8 cm, green, concolorous. Adult Alternate, petiolate, lanceolate to narrow-lanceolate, 6.5–16 × 0.7–1.3 cm, dull, green or grey-green, concolorous.

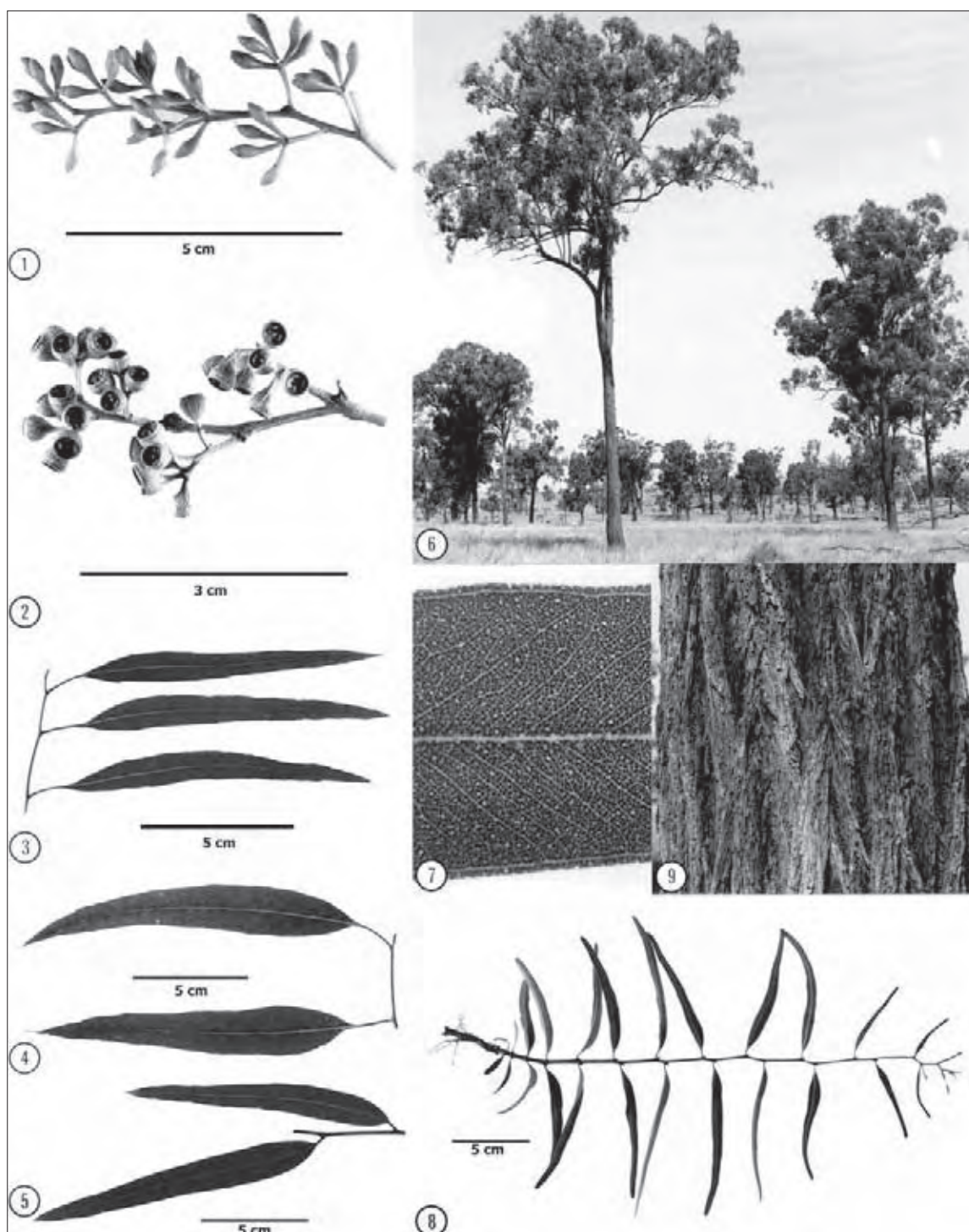
Inflorescences: Axillary or terminal panicles, unit inflorescences 7 to 11-flowered; peduncles terete to angular, 0.4–1.2 cm long; pedicels angular, 0.1–0.6 cm long, the angles often continuing as faint ribs along the hypanthia; buds clavate or diamond-shaped, 0.3–0.8 × 0.2–0.4 cm; opercula conical or hemispherical, often apiculate. Flowers May–Jan.

Fruits: Pedicellate, ovoid, hemispherical or cupular, 0.25–0.7 × 0.25–0.6 cm; disc relatively broad, more or less level or descending; valves 3 or 4, varying from slightly exerted to deeply enclosed. Seeds ovoid to compressed-ovoid, grey-brown, hilum ventral.

Wood: Sapwood yellowish or pinkish white, resistant to attack by *Lyctus* borers; heartwood red-brown to dark red, pinner-textured than other red ironbarks, grain usually interlocked, hard, strong, extremely durable, highly resistant to decay when in contact with the ground and resistant to termite attack; density 890–1200 kg m⁻³; used for heavy engineering construction, poles, railway sleepers, cross-arms and flooring.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest months: 26–35°C/0–17°C; Frost incidence: low to moderate (5–50 each year at southern inland sites and higher elevations); Rainfall: 450–1900 mm per year, mainly summer max.

Distinctive features: A tree with deeply furrowed ironbark, rough to the small branches; adult leaves narrow, dull, green or grey-green; inflorescences axillary or terminal panicles; one of the smaller-fruited ironbarks.



Eucalyptus crebra 1. Buds 2. Fruits 3. Adult leaves 4. Intermediate leaves 5. Juvenile leaves 6. Stand, south-west of Mundubbera, Qld 7. Adult leaf venation 8. Seedling 9. Bark

Slender-leaved Ironbark

Eucalyptus exilipes Brooker & A.R. Bean

Slender-leaved ironbark is a medium-sized to tall tree, occasionally to 35 m tall and with a dbh up to 0.9 m. It is usually erect, branching at above half tree height to form a crown of notably narrow, bluish green to grey-green leaves.

Slender-leaved ironbark has a very restricted distribution in northern Queensland. It is most common in the White Mountains region, south-west of Townsville, and there are several outlying smaller stands, which extend south to the Burra Range and Wantima Homestead.

Slender-leaved ironbark grows on weathered sandstone ridges and adjacent plains, often with outcropping rock. Soils range from shallow sands on ridges to loams and clay loams on plains and are derived from sandstone or alluvium.

This species occurs mainly in woodlands and open forests. Associated species include a range of bloodwoods (*E. trachyphloia*, *E. lamprophylla*, *E. clarksoniana*, *E. leichhardtii*, *E. citriodora*), white mahogany (*E. mediocris*), Queensland peppermint (*E. exserta*), yellowjacket (*E. similis*) and lancewood (*Acacia shirleyi*).

Related species: The ironbarks consist of many species, which divide into two groups diagnosed by the inflexed or non-inflexed stamens. Slender-leaved ironbark belongs to a large group of species in the latter group (subsection *Apicales*) in series *Siderophloiae*, which consists of about 20 species (Brooker 2000). Some of these species are extremely widespread, and may be confused with slender-leaved ironbark and which may overlap in distribution, particularly narrow-leaved red ironbark (*E. crebra*). This species differs by the slightly broader leaves which have an intramarginal vein and the larger, more robust pedicels, buds and fruits. The character that distinguishes slender-leaved ironbark from all other ironbarks (and almost all other eucalypts) is the lack of an intramarginal vein in the adult leaves, which can be ascertained by viewing a fresh leaf with transmitted light. The crowded, linear leaves of regrowth are also very conspicuous in the field.

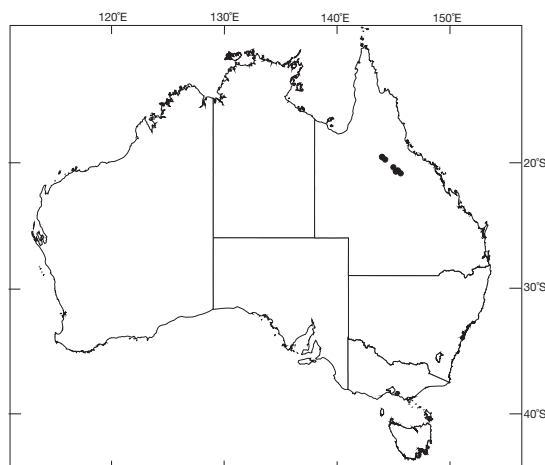
Publication: *Brunonia* 10, 189 (1987). Type: White Mountains, Torrens Creek catchment, Queensland, 2 May 1985, M.I.H. Brooker 8970 & A.R. Bean.

Names: Botanical Latin *exili-* (slender), *pes* (foot) referring to the very slender pedicels.

Bark: Ironbark, persistent to the small branches, slightly baky, ridged and deeply furrowed, densely impregnated with kino, blackish.

Leaves: Seedling Opposite for 4–6 pairs, petiolate, linear, to 0.9 × 0.5 cm, dull, light green to bluish green, discolorous. Juvenile Alternate, shortly petiolate, linear, crowded, to 9 × 0.2–0.5, green. Adult Alternate, shortly petiolate, linear or falcate, to 9 × 0.8 cm, dull to very slightly glossy, yellowish green to green, concolorous, lacking an intramarginal vein.

Inflorescences: Mostly axillary with some terminal panicles, 7-flowered; peduncles slender, to 0.8 cm long; pedicels slender, delicate; buds fusiform, to 0.6 × 0.2 cm; opercula conical. Flowers Jun.–Sept.

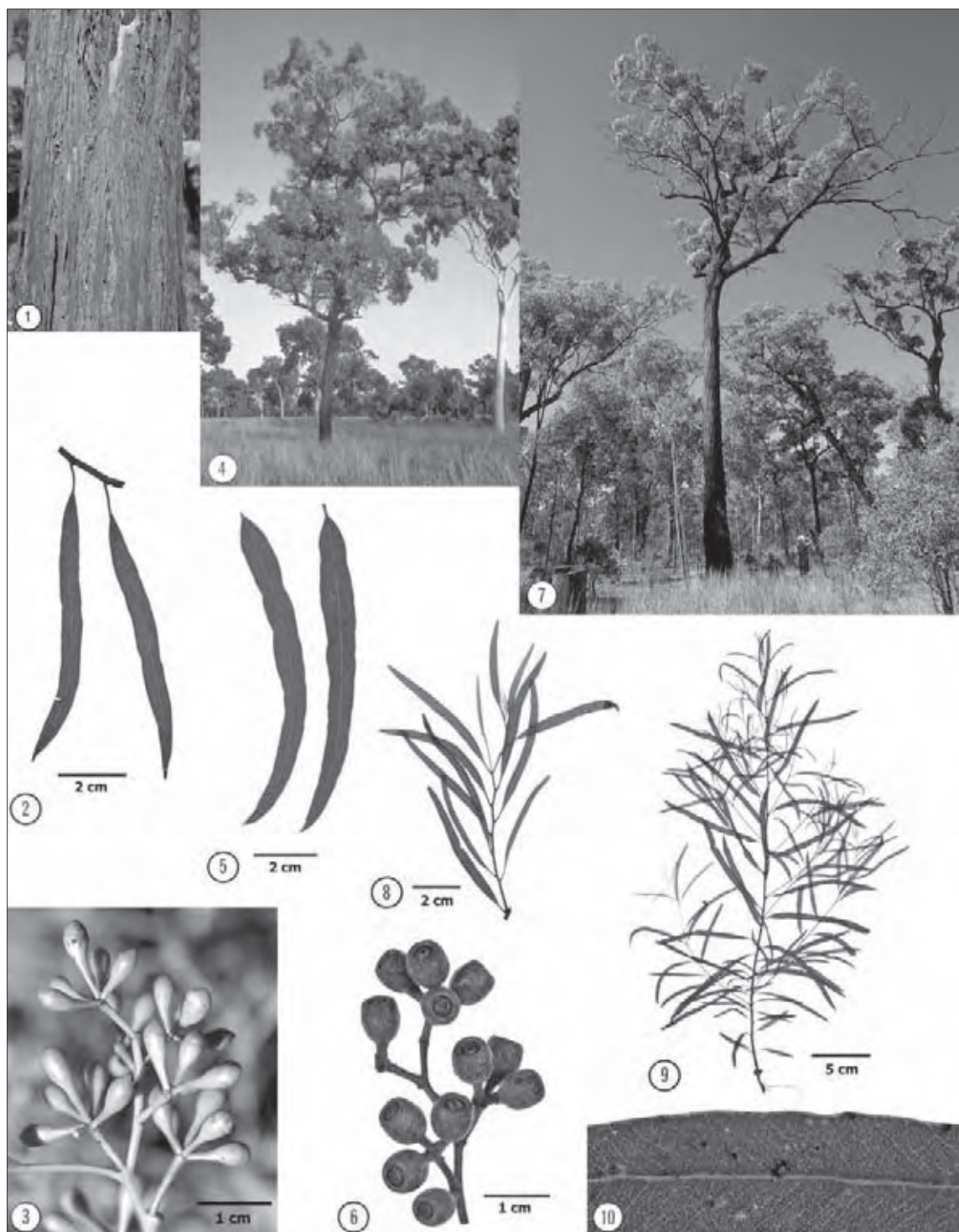


Fruits: Pedicellate, cupular, to 0.6 × 0.4 cm, rim thin; disc descending; valves 3 or 4, to rim level. Seeds ovoid to compressed-ovoid, grey-brown to dark grey, hilum ventral.

Wood: Poorly known but likely to be similar to related ironbarks which typically have hard, strong and extremely durable wood; density likely to be in excess of 1000 kg m⁻³.

Climate: Altitudinal range: 350–920 m; Hottest/coldest months: 31–34°C/7–8°C; Frost incidence: low; Rainfall: 600–750 mm per year, summer max.

Distinctive features: Small to medium-sized or tall, erect tree, with blackish ironbark to the small branches; delicate narrow juvenile leaves of regrowth; adult leaves very narrow and lacking an intramarginal vein; pedicels, buds and fruits small, delicate.



Eucalyptus exilipes 1. Bark 2. Adult leaves 3. Buds 4. Tree, Valley of Lagoons, Qld 5. Intermediate leaves 6. Fruits 7. Tree, near Hughenden, Qld 8. Seedling leaves 9. Seedling 10. Adult leaf venation

Lemon-scented Ironbark

Eucalyptus staigeriana F. Muell. ex. F.M. Bailey

Lemon-scented ironbark is typically a tree of moderate size up to 20 m in height and 0.6 m in diameter, with a bole which is sometimes half or more of tree height and fairly straight, but may be short and of poor, straggly form. The major branches usually ascend steeply to form the framework of a rather narrow and open crown. Some trees, especially those with a short trunk, have more spreading branches and a crown which may be nearly as wide as the tree is high.

Lemon-scented ironbark occurs on Cape York Peninsula in northern Queensland. The principal areas are in the headwaters of the Palmer River and centred about 80–130 km south-west of Cooktown and includes the area Maytown to Palmerville and the granitic hills to the east of Maitland Downs.

This species mainly grows on undulating to somewhat hilly topography. It occurs most often on granitic hills where there are massive granitic boulders. Growing conditions are unfavourable for most plants. The soils include free draining sands and skeletal types.

Lemon-scented ironbark is a woodland or low woodland species. It occurs with a limited number of other eucalypts, including Clarkson's bloodwood (*E. clarksoniana*), Cullen's ironbark (*E. cullenii*), Gympie messmate (*E. cloeziana*), Darwin stringybark (*E. tetradonta*), species of *Petalostigma* and *Xanthorrhoea*, and sparse tropical grasses.

Related species: Brooker (2000) placed lemon-scented ironbark in the series *Siderophloiae* in the large subseries *Subglaucae* (only four species were included by Blakely in 1934). The subseries comprises about 20 species, many of which have been discovered and published since 1984. Lemon-scented ironbark is easily recognised among the ironbarks by the lemon-scented adult leaves. It is most closely related to Wandji ironbark (*E. jensenii*) of Western Australia and the Northern Territory, which lacks lemon-scented leaves.

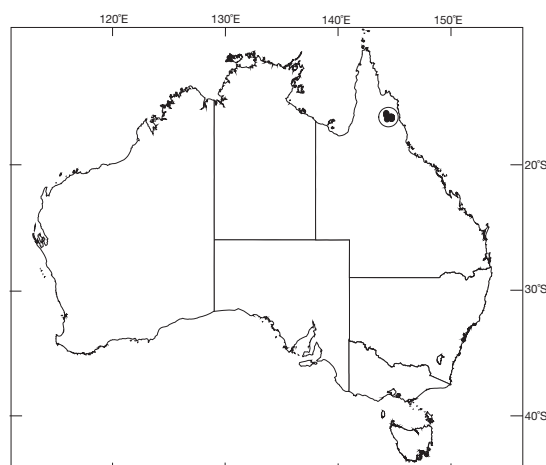
Publication: *Syn. Queensland Flora* 176 (1883). Type: Cooktown district, Palmer River, Queensland, P.A. Sellheim.

Names: Botanical honours Karl Theodore Staiger (1833–1888), Government Analytical Chemist in Queensland. Common refers to the lemon-scented oils and bark type.

Bark: An ironbark; thick, very hard, deeply fissured longitudinally, black; persistent to the small branches.

Leaves: Seedling opposite for 3–5 pairs, shortly petiolate, linear, 3.8–7.5 × 0.2–0.8 cm. Juvenile alternate, petiolate, ovate to elliptical, 6–8 × 3–4 cm, concolorous. Intermediate alternate, petiolate, broad-lanceolate, 15–17 × 7.5–8.5 cm, pruinose, concolorous. Adult alternate, petiolate, lanceolate, 12–14 × 2–3 cm, pruinose, concolorous; conspicuously lemon-scented with the aldehyde citral.

Inflorescences: Small to moderately large axillary or terminal panicles, unit inflorescences 7 to 11-flowered; peduncles somewhat flattened, 0.2–1.3 cm long, pedicellate; buds fusiform, to 0.7 × 0.4 cm; opercula conical to beaked. Flowers Dec.–Apr.

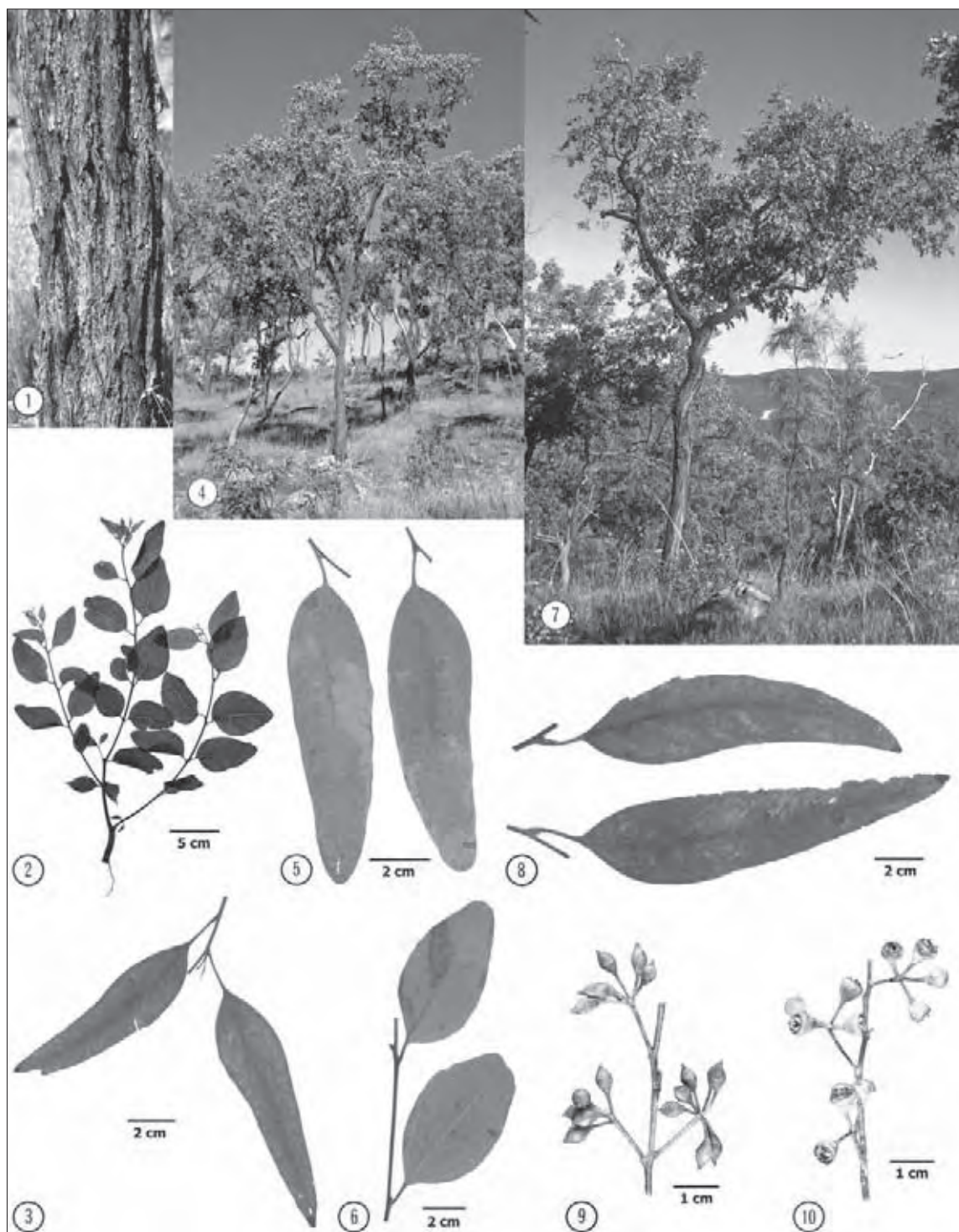


Fruits: Cupular, pedicellate, 0.5–0.6 × 0.3–0.5 cm; disc narrow, depressed; valves 3 or 4, rim level or slightly exserted. Seeds ovoid to compressed-ovoid, grey-brown, hilum ventral.

Wood: Heartwood red, strong and very durable; density 1135 kg m⁻³, can be used for most purposes where a good quality ironbark is desirable, but its small stature and restricted occurrence suggests only limited local use for fencing.

Climate: Altitudinal range: 240–750 m; Hottest/coldest months: 28–31°C/11–13°C; Frost incidence: low; Rainfall: 850–1150 mm per year, summer max.

Distinctive features: An often straggly ironbark tree growing on hilly sites where growing conditions are unfavourable; bark rough to small branches; leaves with a strong lemon scent of citral; small to moderately large axillary or terminal panicles; buds and fruits distinctly pedicellate; capsules small, cupular with slightly exserted valves.



Eucalyptus staigeriana 1. Bark 2. Seedling 3, 8. Adult leaves 4, 7. Trees, Maitland Downs, Qld 5. Intermediate leaves 6. Juvenile leaves 9. Buds 10. Fruits

Wandi Ironbark

Eucalyptus jensenii Maiden

Wandi ironbark is usually a small tree, 6–12 m in height and up to 0.6 m diameter in mature specimens. The trunk is up to half the tree height and is usually of poor form before it divides to provide the framework of a small but, sometimes, moderately dense crown. Trees to 18 m tall, with a clear 12 m bole, are known from some parts of its range.

Wandi ironbark occurs in the Northern Territory from the upper Roper River catchment northwards and includes the north coast and islands of the Gulf of Carpentaria. In Western Australia it occurs in large stands in the Kimberley region. Several outlying stands occur to the south of its main range such as at the Edgar Ranges south-east of Broome. It attains its best development in Arnhem Land, Northern Territory.

This species grows mainly on gentle to moderate slopes and sometimes on tablelands. Only to a limited extent does it grow on lowlands or near swampy depressions. Soils range from sandy and lateritic skeletal types to light grey duplex soils.

Wandi ironbark occurs in pure stands or as scattered specimens or in small groups in open forests or woodlands with eucalypts such as large-leaved cabbage gum (*E. grandifolia*), long-fruited bloodwood (*E. polycarpa*) and tjuta (*E. terminalis*). On some sites it may be associated with a limited number of tree species, for example, on skeletal soils in Western Australia it occurs characteristically with northern white gum (*E. brevifolia*), on lateritic tablelands with twin-leaved bloodwood (*E. cadophora*), and on the edges of coastal swamps with broad-leaved tea tree (*Melaleuca leucadendra*).

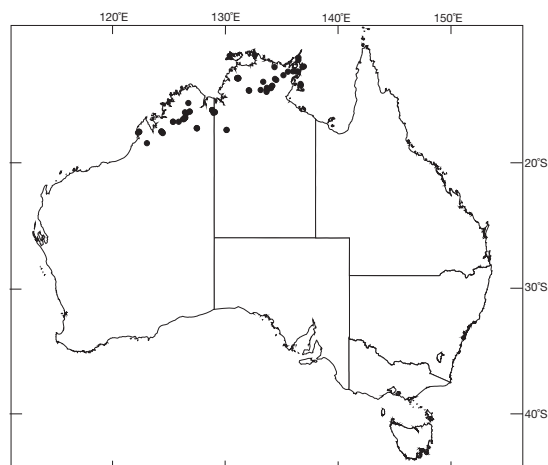
Related species: Brooker (2000) followed Blakely (1934) and placed Wandi ironbark in the series *Siderophloiae* in the now large subseries *Subglaucae* (only four species were included in 1934). The subseries comprises about 20 species, many of which have been discovered and published since 1984. Wandi ironbark is easily recognised in the field, as it is the only ironbark in its area of natural occurrence. Among the other ironbarks of the group, it is distinct by the combination of relatively short, broadish, grey-green adult leaves and relatively small buds and fruits. It is most closely related to lemon-scented ironbark (*E. staigeriana*) of far northern Queensland which is easily distinguished by the lemon-scented leaves.

Publication: *Critic. Revis. Eucalyptus* 6, 255 (1922). Type: Wandi, Northern Territory, Apr. 1916, H.I. Jensen 372.

Names: Botanical honours H.I. Jensen (1879–1966), the collector of the type and a geologist who established plant collections in northern Australia. Common refers to the type locality and bark type.

Bark: An ironbark, persistent to the small branches; compact texture, thick, grey to almost black, divided longitudinally by rough fissures on the trunk but somewhat scaly on the small branches.

Leaves: Seedling opposite, very shortly petiolate for 8–15 pairs, linear, 2.5 × 0.1–0.3 cm; becoming subopposite, shortly petiolate, lanceolate, 3.8–6.5 × 0.5–1 cm. Juvenile



subopposite to alternate, shortly petiolate, broad-lanceolate to ovate, 7.5–10 × 1–2.5 cm. Intermediate stage not distinctive but shows a transition between juvenile and adult. Adult alternate, petiolate, broad-lanceolate to oblong-lanceolate, 6–10 × 1–2.5 cm, dull, grey to bluish green.

Inflorescences: Short, terminal panicles or axillary, unit inflorescences 3 or 7-flowered; peduncles to 0.5 cm long, pedicellate; buds ovoid, to 0.4 × 0.4 cm, more or less pruinose; opercula hemispherical.

Fruits: Cupular to turbinate, to 0.4 × 0.4 cm, disc obscure, valves 3 or 4, included or slightly exserted. Young fruits commonly slightly pruinose. Seeds ovoid to compressed-ovoid, grey-brown, hilum ventral.

Wood: Poorly known but reported to be hard and durable; density probably similar to lemon-scented ironbark (*E. staigeriana*) which is over 1100 kg m⁻³, used for fence and yard posts.

Climate: Altitudinal range: near sea level to 535 m; Hottest/coldest months: 31–36°C/9–20°C; Frost incidence: low; Rainfall: 600–1300 mm per year, summer max.

Distinctive features: Small ironbark tree; adult leaves short, dull, grey to bluish green; buds and fruits small, usually pruinose; the only ironbark species in Western Australia and the Northern Territory.



Eucalyptus jensenii 1. Adult leaves 2. Intermediate leaves 3. Fruits 4. Buds 5. Seedling 6. Tree, near Edgar Ranges, W.A. 7. Tree, Adelaide River region, N.T. 8. Bark

Silver-leaved Ironbark

Eucalyptus melanophloia F. Muell.

Silver-leaved ironbark is commonly a small to medium-sized tree of fair to poor form, 6–20 m in height, but occasionally attaining 25 m with dbh around 0.3–0.6 m. The canopy often forms the upper two-thirds of the tree height. This species has a low mallee habit in the disjunct outlier population south of Mt Isa.

The main occurrence of silver-leaved ironbark is in an extensive area in the semi-arid regions of inland New South Wales, north from Dubbo and north of Bourke, and in Queensland south from north-west of Mareeba west to Adavale and with a disjunct occurrence west of Georgetown. The distribution approaches the coast in southern and central Queensland and includes the Brisbane region. There are numerous outlying stands including several in central New South Wales, on Cape York in northern Queensland and a small occurrence of the mallee form south of Mt Isa.

This species is generally found on the gentle topography of plains and tablelands. Best development is on moderately fertile silts, loams and sandy clays, but it occurs on a wide range of soils including gravels and poor sands.

Silver-leaved ironbark is a woodland or low woodland species, associated with a wide range of eucalypts including bumble box (*E. populnea*), ghost gum (*E. aparrerinja*), carbeen (*E. tessellaris*), narrow-leaved red ironbark (*E. crebra*), Clarkson's bloodwood *E. clarksoniana*, and mountain coolibah (*E. orgadophila*); other species include brigalow (*Acacia harpophylla*), mulga (*A. aneura*) and cypress pines (*Callitris glaucophylla* and *C. endlicheri*).

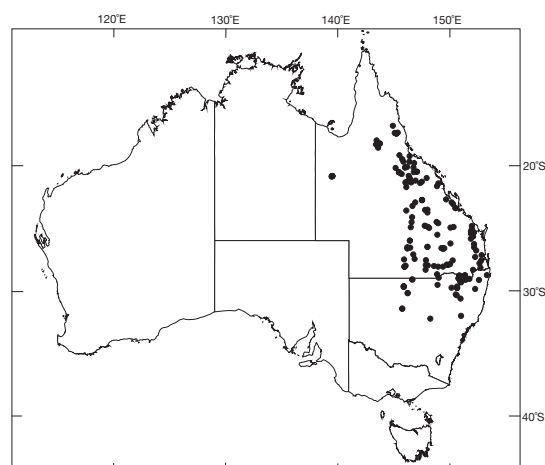
Related species: Brooker (2000) followed Blakely (1934) and placed silver-leaved ironbark in series *Siderophloiae* in subseries *Jugatae*. Silver-leaved ironbark is close to another silver-leaved ironbark, *E. shirleyi*. The two species are easily recognised in the field by their reproductively mature crowns wholly comprising roundish or broad-lanceolate, bluish juvenile leaves. As such they cannot be confused with any other ironbarks. Shirley's silver-leaved ironbark, of much more restricted distribution, is a smaller tree with broader leaves and larger buds and fruits. The two species intergrade over a large area north of Jericho (A.R. Bean, Queensland Herbarium, pers. comm.).

Publication: *J. Proc. Linn. Soc.* 3, 93 (1859). Types: Subtropical Australia (Queensland), 5 Mar. 1846, T.L. Mitchell 485.

Names: Botanical Greek *melanos* (black), *phloios* (bark). Common refers to the colour of the leaves of the mature crown and to the bark.

Bark: Ironbark persistent to the small branches, hard, dark grey to black, deeply fissured longitudinally, more rarely with smooth branches.

Leaves: Seedling opposite, sessile or very shortly petiolate, ovate to almost orbicular, 5–8 × 2–6 cm, greyish green, slightly discolourous. Juvenile opposite, sessile or shortly petiolate, ovate to orbicular, or cordate, often amplexicaul, 7–10.5 × 4–10.5 cm, greyish green, slightly discolourous at first, later leaves becoming concolorous. Intermediate opposite,



sessile to very shortly petiolate, ovate, 7.5–10.5 × 3–5.5 cm, bluish green, subpruinose concolorous. Adult (rarely formed) opposite, shortly petiolate, ovate to broad-lanceolate, 5–9 × 2–3 cm, bluish green, subpruinose, concolorous. Stems and petioles are pruinose at all stages.

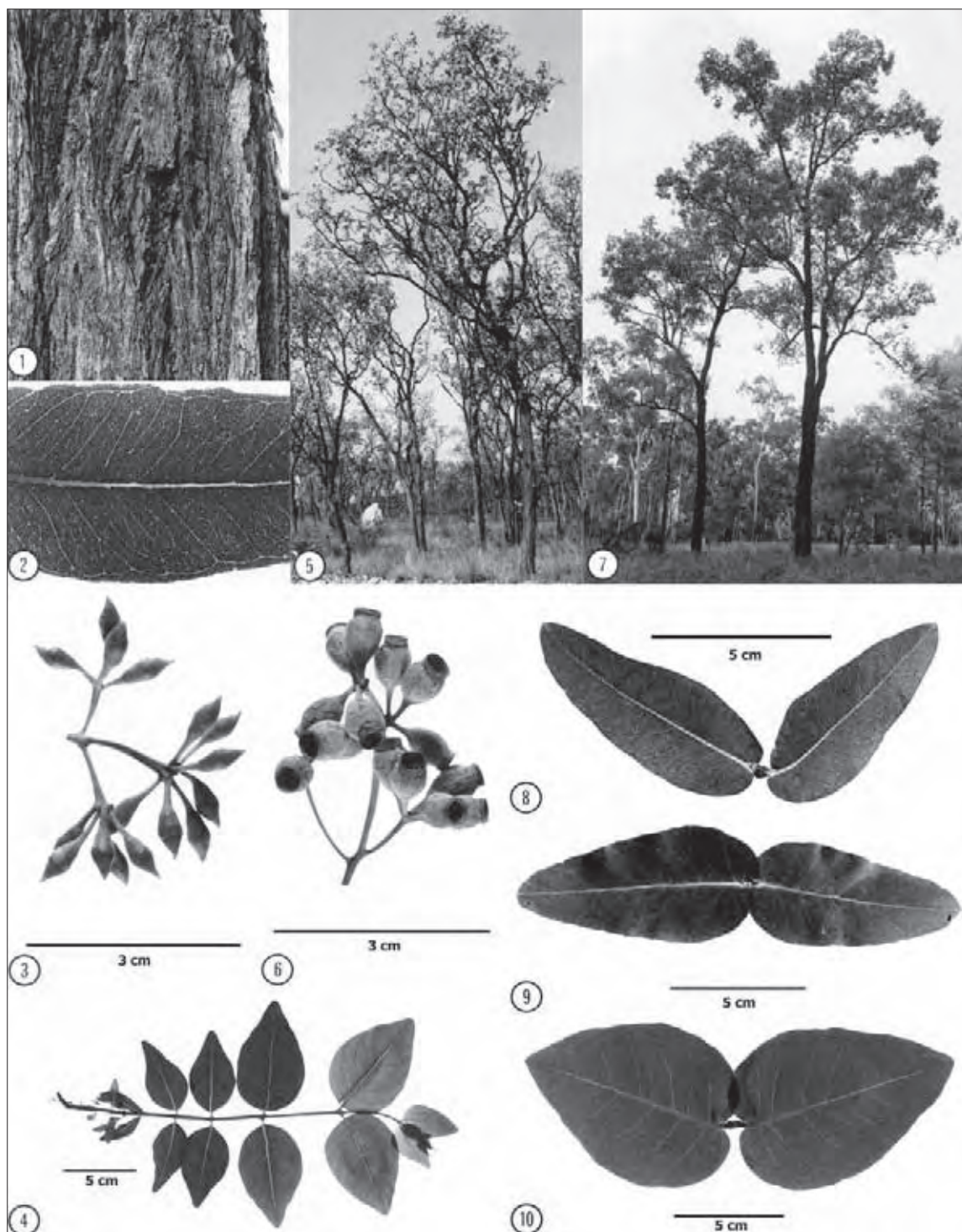
Inflorescences: Axillary and terminal panicles, unit inflorescences 7-flowered; peduncles terete to angular, 0.4–1.6 cm long; pedicels occasionally absent, or 0.1–1 cm long, often angular, the angles continuing as faint ribs along the hypanthia; buds diamond-shaped, 0.4–0.8 × 0.2–0.4 cm, pruinose; opercula usually conical, occasionally hemispherical-apiculate. Flowers Sept.–Feb.

Fruits: Usually pedicellate, ovoid, hemispherical, subglobose, or occasionally urceolate, 0.3–0.8 × 0.4–0.8 cm, pruinose, often with ribs continuing from the angular pedicels; disc of medium width, steeply descending; valves usually 4, about rim level or slightly exserted. Seeds ovoid, slightly compressed, brown, hilum ventral.

Wood: Sapwood resistant to attack by *Lyctus* borers; heartwood red, hard, heavy, durable and termite resistant; density about 1090 kg m⁻³; used for fencing and local farm construction.

Climate: Altitudinal range: 80–1150 m; Hottest/coldest months: 27–35°C/1–12°C; Frost incidence: low to moderate (3–50 each winter at southern inland sites); Rainfall: 350–1100 mm per year, summer max.

Distinctive features: An ironbark tree; bark rough to the small branches, rarely smooth on branches; pruinose buds, fruits and branchlets; leaves bluish green, opposite at all stages; leaves of mature crown very shortly petiolate; inflorescences 7-flowered, in axillary or terminal panicles.



Eucalyptus melanophloia 1. Bark 2. Adult leaf venation 3. Buds 4. Seedling 5. Stand, west of Herberton, Qld 6. Fruits 7. Trees, north of Tambo, Qld 8. Adult leaves 9. Intermediate leaves 10. Juvenile leaves

■ The *Terminales* Boxes, Gums and Ironbarks

Eucalyptus subsection *Terminales* (Maiden)
Brooker

This is a group of about 30 species distributed principally over south-eastern Australia, from Eyre Peninsula in the west throughout the plains, tablelands and lower ranges of moderately well-watered parts of South Australia, Victoria, New South Wales and as far north as the Consuelo Tableland and Kroombit Tops in Queensland. The exception to this general distribution is the curious relict species *E. lucens*, which is endemic to a few ranges near Alice Springs in central Australia.

Most of the species occur largely in woodlands although some occur in coastal thickets (e.g. *E. leucoxylon*, *E. tricarpa*, *E. fasciculosa*), while other species such as grey ironbark (*E. paniculata*), Rudder's box (*E. rudderi*), yellow box (*E. melliodora*) and red ironbark (*E. tricarpa*), in the higher rainfall parts of their distribution, occur in open forests.

All the species produce strong, hard, durable timber but most are not trees of suitable form to be of much use for construction purposes, apart from *E. paniculata*, *E. rudderi*, *E. melanoleuca* and

E. leucoxylon. However, some of the remaining species are valued for other purposes, e.g. *E. melliodora* is an important honey-producer while *E. sideroxylon* and *E. leucoxylon* are popular red-flowering ornamentals.

Botany

The *Terminales* group comprises three distinct series: *Heterophloiae*, consisting of boxes and gums, in which the inflorescences are conspicuously terminal and whose buds lose the outer operculum early; *Rhodoxylon*, consisting of ironbarks only, in which the inflorescences are conspicuously terminal and whose buds lose the outer operculum early; and *Melliodorae* which include two gums, a box and two ironbarks in which the inflorescences are mostly axillary, and whose buds hold the outer operculum until flowering.

The buds in the series *Melliodorae* are therefore smooth, while those of the series *Heterophloiae* and *Rhodoxylon* always have a median scar towards maturity, indicating the ring of attachment of the fallen outer operculum.

The name *Terminales* was introduced by Maiden (1924) in his classification of the eucalypts based on the anthers, which in this group open by terminal pores, although this character is not exclusive to the *Terminales*.



Yellow box (*Eucalyptus melliodora*) is one of numerous species whose natural populations have been highly fragmented due to agricultural, urban or industrial development. 1–2. *E. melliodora* on grazing land surrounding Canberra, A.C.T. 3. *E. melliodora* in suburban Canberra, A.C.T.

Red Box

Eucalyptus polyanthemos Schauer

Red box is a medium-sized tree 15–25 m in height and 0.5–1 m dbh under favourable conditions, and under poorer conditions may only be about 10 m in height with dbh 0.3–0.4 m. The trunk is often short and of mediocre form, and the crown generally rounded and quite dense. It consists of three subspecies, the typical, subsp. *vestita* and subsp. *longior*.

Subsp. *polyanthemos* occurs widely on the central and south-western slopes and the lower altitudes of the Central and Southern Tablelands of New South Wales. Subsp. *vestita* is widespread in central and eastern Victoria from Ararat eastwards, extending into New South Wales north of Albury and at Bombala. Subsp. *longior* occurs along the foothills of far eastern Victoria from near Bairnsdale (e.g. Mt. Taylor) east to the New South Wales border.

Red box grows on foothills, lowland ranges and gentle slopes between the open plains and higher mountain slopes. It is generally found on dry stony or gravelly soils and rather heavy, poor soils, generally of sedimentary origin.

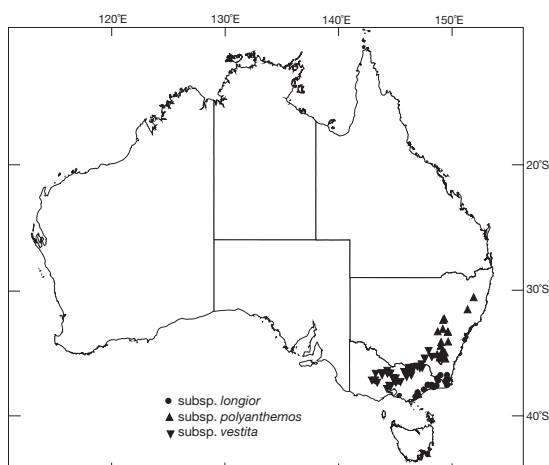
This species occurs in grassy eucalypt woodlands usually associated with yellow box (*E. melliodora*), Blakely's red gum *E. blakelyi*, red stringybark (*E. macrorhyncha*), scribbly gum (*E. rossii*), apple box (*E. bridgesiana*), long-leaved box (*E. gonicalyx*), broad-leaved peppermint (*E. dives*), brittle gum (*E. mannifera*) and red ironbark (*E. sideroxylon*).

Related species: Red box is closest to blue box (*E. baueriana*) of coastal New South Wales (south from Sydney) which differs by the completely rough bark and glossy green, rounder adult leaves. Other related species are completely rough-barked (*E. rudderi*, *E. conica*, *E. hypostomatica*) or smooth-barked (*E. fasciculosa* and *E. lucens*). Red box may be confused with yellow box (*E. melliodora*). It differs in having small elliptical to narrowly ovate juvenile leaves, lanceolate to narrow-lanceolate adult leaves and mostly axillary inflorescences.

Publication: Subsp. *polyanthemos*: in Walpers Repert. Bot. Syst. 2, 924 (1843). Type: Bathurst area, New South Wales, 1822, A. Cunningham 136. Subsp. *vestita* L.A.S. Johnson & K.D. Hill: Telopea 4, 75 (1990). Type: Kinglake Road near St Andrews, Victoria 14 Mar. 1965, P. Carolan. Subsp. *longior* Brooker & Slee: Muelleria 9, 82 (1996). Type: 4.6 km along Ostler's Gap Road from Waygara Track Junction; N of Waygara, Victoria, 17 Nov. 1993, M.I.H. Brooker 11637 and A. Slee.

Names: Botanical Greek *poly* (much, many), *anthemos* (flower), refers to the many flower buds in each panicle; Latin *vestitus* (clothed) referring to the completely rough bark; Latin *longior* (longer), referring to the longer, narrower adult leaves. Common refers to the heartwood colour and to the box group of eucalypts.

Bark: Shed from the trunk and branches in irregular short strips, often remaining partly detached, leaving a greyish or cream to white surface (*polyanthemos*); trunk and limbs subpubescent to pubescent, box-type, brownish or greyish rough bark (*vestita* and *longior*).



Leaves: Seedling opposite for 4 or 5 pairs then alternate, petiolate, more or less orbicular, often broader than long, 2.5–6 × 2–7 cm, bluish green, concolorous. Juvenile alternate, petiolate, orbicular, usually wider than long, often emarginate 5–6.5 × 5–8 cm, bluish green, concolorous. Intermediate alternate, petiolate, ovate, 6–9 × 3.5–5 cm, bluish green, concolorous. Adult alternate, petiolate, ovate, elliptical to broad-lanceolate, 5.5–9 × 1.5–3.5 cm (*polyanthemos* and *vestita*), 6–14 × 1.5–3 cm (*longior*), bluish green, concolorous.

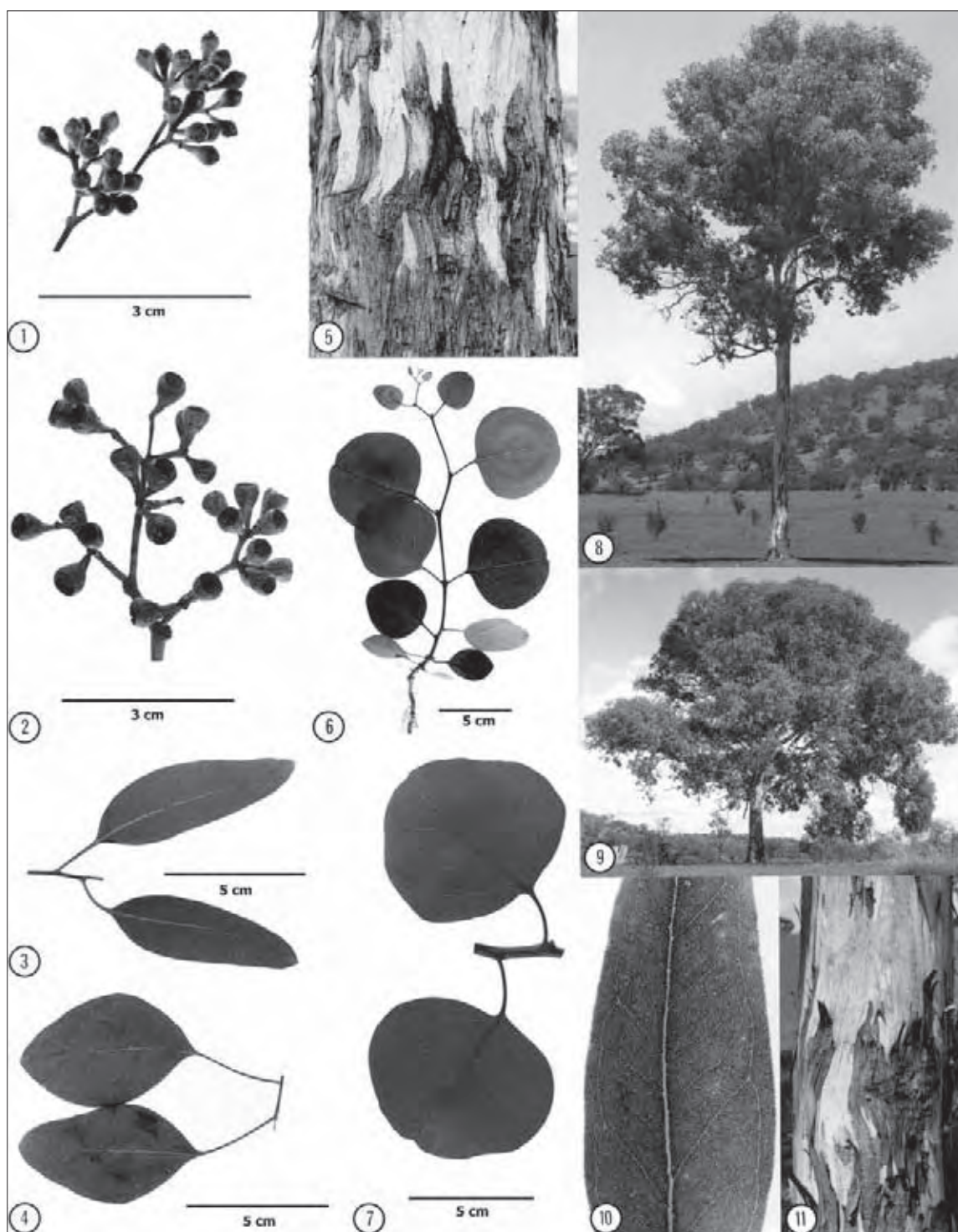
Inflorescences: Axillary or terminal panicles, unit inflorescences 7-flowered; peduncles terete, often pruinose, 0.5–1.5 cm long; pedicels angular, often pruinose, 0.1–0.9 cm long; buds ovoid to clavate, often pruinose, 0.5–0.6 × 0.3–0.4 cm; opercula conical or more or less hemispherical-apiculate, narrower than the hypanthia at the join. Flowers Sept.–Dec.

Fruits: Pedicellate, pyriform, obconical (sometimes slightly flared at the rim), or occasionally more or less hemispherical, 0.4–0.7 × 0.4–0.6 cm, sometimes pruinose; rim thin, often split; disc relatively broad, descending; valves (3)4(5), enclosed. Seeds slightly compressed, brown, hilum ventral.

Wood: Sapwood *Lyctus* susceptible, heartwood red, with fine texture and interlocked grain, hard, tough, strong and moderately durable but resistant to termites, dries slowly, difficult to season; density 950–1115 kg m⁻³, used for fencing and is an excellent firewood.

Climate: Altitudinal range: 120–780 m (*polyanthemos*, *vestita*), 120–450 m (*longior*); Hottest/coldest months: 23–30°C/1–4°C (*polyanthemos*, *vestita*), 22–25°C/2–4°C (*longior*); Frost incidence: moderate to high, with up to 60 each winter at higher elevations (*polyanthemos*, *vestita*), moderate (*longior*); Rainfall: 450–970 mm per year, uniform and winter max. (*polyanthemos*, *vestita*), 800–1100 mm per year, uniform (*longior*).

Distinctive features: Medium-sized tree with variation in bark from fully smooth-barked to partly rough-barked (*polyanthemos*) or completely rough-barked (*vestita* and *longior*); orbicular juvenile leaves and ovate intermediate leaves common in mature crown in subspp. *polyanthemos* and *vestita*, lanceolate in subsp. *longior*; all leaves with a bluish appearance; terminal panicles.



Eucalyptus polyanthemos subsp. *polyanthemos* 1. Buds 2. Fruits 3. Adult leaves 4. Intermediate leaves 5, 11. Bark 6. Seedling 7. Juvenile leaves 8, 9. Trees, Canberra, A.C.T. 10. Adult leaf venation

Grey Ironbark

Eucalyptus paniculata Smith

Grey ironbark is usually a medium-sized to tall tree up to 30 m in height, to 1 m dbh and of good form. On favourable sites it may reach 50 m and dbh of 1.5 m with long, straight trunks. The crown is heavy and compact in the young tree, especially on good sites, but with age it becomes more open.

This species is endemic to coastal and subcoastal New South Wales extending from near Bega in the south to about Coffs Harbour in the north, mainly within 80 km of the coast.

This species grows on a wide range of topography from valley bottoms to the slopes and tops of ridges and hills. Although the species prefers good soils, especially fertile, sandy loams, with moderately heavy subsoils, it has the ability to grow moderately well on poor stony ridges.

Grey ironbark occurs in open or tall open forests, rarely in pure stands, but on relatively poorer and more freely drained sites it may be the main species. Commonly associated eucalypts include bloodwoods (*E. maculata*, *E. gummifera*, *E. intermedia*), blackbutt (*E. pilularis*), coast grey box (*E. bosistoana*), woollybutt (*E. longifolia*), stringybarks (*E. agglomerata*, *E. globoidea*, *E. muelleriana*), grey gums (*E. punctata*, *E. propinqua*) and forest red gum (*E. tereticornis*).

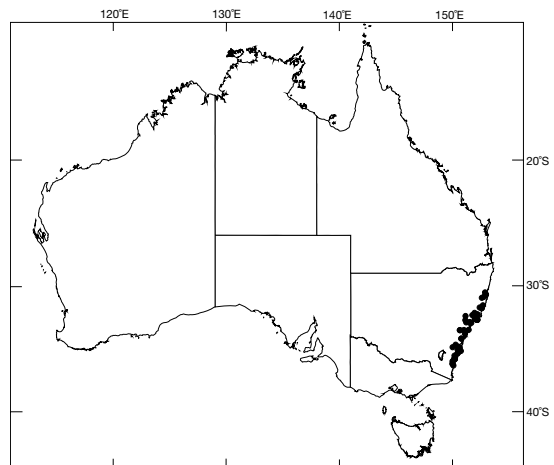
Related species: Grey ironbark belongs in subsection *Terminales*, series *Rhodoxylon* with four other species (Brooker 2000). *Rhodoxylon* divides into two subseries, which can be distinguished by the discolorous adult leaves (subseries *Discolores*) and those with concolorous adult leaves (subseries *Concolores*). Grey ironbark belongs in the former group and is close to the cryptic *E. fergusonii*, which might be disregarded as a species in the field, as it appears to be disappearing as a distinct taxon through extensive intergradation with grey ironbark. *E. fergusonii* subsp. *dorsiventralis* from the Wollombi Valley foothills north-west of Sydney is more distinct than the typical subspecies. Two species recognised by Johnson and Hill (1990), *E. placita* (glossy light green, distinctly discolorous adult leaves) and *E. ancophila* (\pm glossy green adult leaves, slightly discolorous or concolorous) are minor variants of grey ironbark. The *Rhodoxylon* species are easily distinguished from the other ironbarks, which shed the outer operculum early, and by the strongly inflexed stamens.

Publication: *Trans. Linn. Soc. London* 3, 287 (1797). Type: Port Jackson, New South Wales, D. Burton.

Names: Botanical Latin *paniculatus* (paniculate), of the inflorescence. Common refers to the bark.

Bark: Ironbark, persistent to the small branches, hard, deeply furrowed and ridged, grey (lighter than most ironbarks), impregnated with kino.

Leaves: Seedling Opposite for a few pairs then alternate, petiolate, ovate, 4.8×3.5 cm, green, strongly discolorous. Juvenile Alternate, petiolate, ovate to broad-lanceolate, 8.16×3.36 cm, green, strongly discolorous. Intermediate Alternate, petiolate, broad-lanceolate to lanceolate, 10.19×2.44 cm, green, discolorous. Adult Alternate, petiolate, lanceolate, 9.5×1.2 cm, thin, green, discolorous.



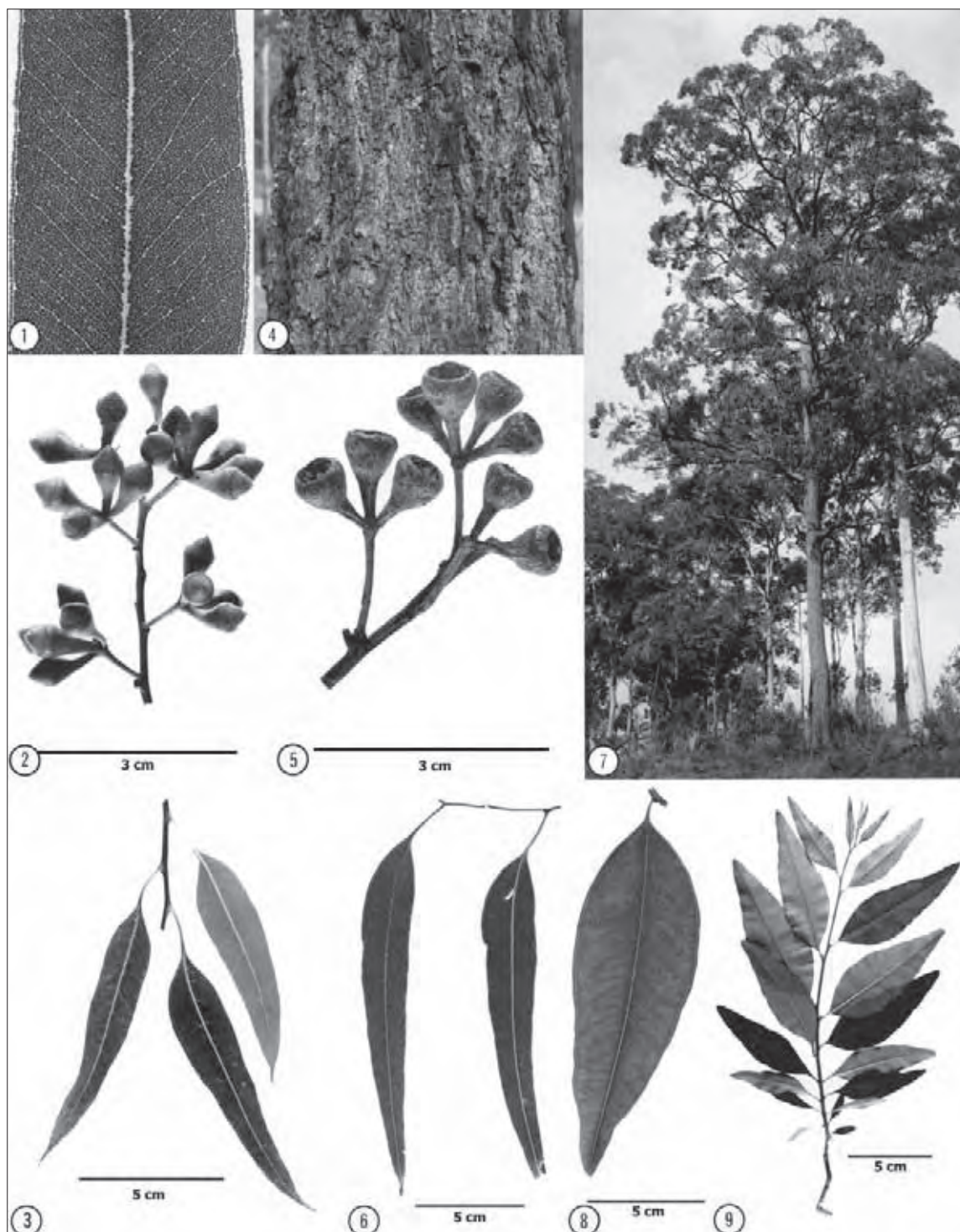
Inflorescences: Mostly terminal panicles, some axillary panicles and some simple axillary inflorescences, unit inflorescences 7-flowered; peduncles angular to flattened, 0.6 ± 1.6 cm long; pedicels strongly angular, 0.2 ± 1 cm long, the angles continuing as ribs along the hypanthia; buds ovoid to diamond-shaped, $0.8 \pm 1.1 \times 0.4 \pm 0.5$ cm; opercula conical, narrower than hypanthia at the join. Flowers May–Feb. depending on district.

Fruits: Pedicellate, ovoid, hemispherical, obconical or pyriform, $0.5 \pm 0.9 \times 0.5 \pm 0.7$ cm, usually faintly ribbed; disc more or less level to descending, usually obscured by staminal ring; valves 4 or 5, about rim level or slightly enclosed. Seeds ovoid, slightly compressed, brown, hilum ventral.

Wood: Sapwood not *Lyctus* susceptible, heartwood dark brown or red-brown with Pn, uniform texture and interlocked grain, very hard, very strong, very durable and termite resistant, tough, not easy to work but turns to a good Pnish; density 1000 ± 1185 kg m⁻³, used for heavy engineering construction, poles, railway sleepers and cross-arms and suitable for heavy-duty flooring.

Climate: Altitudinal range: near sea level to 900 m; Hottest/coldest months: $23 \pm 29^\circ\text{C}/1 \pm 8^\circ\text{C}$; Frost incidence: low to moderate (2 ± 20 each winter at higher elevations); Rainfall: 700 ± 1500 mm per year, uniform.

Distinctive features: Medium-sized to tall tree with coarse, hard ironbark, usually greyish, lighter in colour than most ironbarks; leaves at all stages discolorous; inflorescences mostly terminal panicles; opercula usually conical, narrower than hypanthia; fruits with 4 or 5 valves.



Eucalyptus paniculata 1. Adult leaf venation 2. Buds 3. Adult leaves 4. Bark 5. Fruits 6. Intermediate leaves 7. Tree, south of Moruya, N.S.W. 8. Juvenile leaf 9. Seedling

Yellow Box Honey Box (Qld), Yellow Ironbark (Qld)

Eucalyptus melliodora Cunn. ex Schauer

Yellow box is a medium-sized to occasionally tall tree, 15–30 m in height and up to 1 m or more in diameter, with a trunk one-third to half the tree height. The branchlets are often pendent. The crown is large, spreading and of medium to open density.

Yellow box is abundant and widely distributed in Victoria from the Grampians eastwards and through New South Wales, especially on the inland side of the Great Dividing Range. It also occurs on the tablelands of New South Wales, with a considerable, though scattered, extension into south-eastern Queensland as far as the Carnarvon Range and to south of Gladstone.

This species occurs mainly on gentle slopes and foot-hills, but is restricted to flats near watercourses in the drier part of its range such as the lower Lachlan River. The best development is on light to somewhat heavy alluvial soils, loams and sandy loams.

Yellow box mainly occurs in grassy woodlands or less commonly open forests. It nearly always grows in association with other eucalypts including red box (*E. polyanthemos*), white box (*E. albens*), narrow-leaved grey box (*E. pilligaensis*), inland grey box (*E. microcarpa*), apple box (*E. bridgesiana*), long-leaved box (*E. goniocalyx*) and several red gums, such as Blakely's red gum (*E. blakelyi*). Stringybark associates include red stringybark (*E. macrorhyncha*) and brown stringybark (*E. baxteri*). In Queensland it occurs with red bloodwood (*E. erythrophloia*), grey gum (*E. longirostrata*), grey box (*E. moluccana*), brigalow (*Acacia harpophylla*) and cypress pine (*Callitris* spp.).

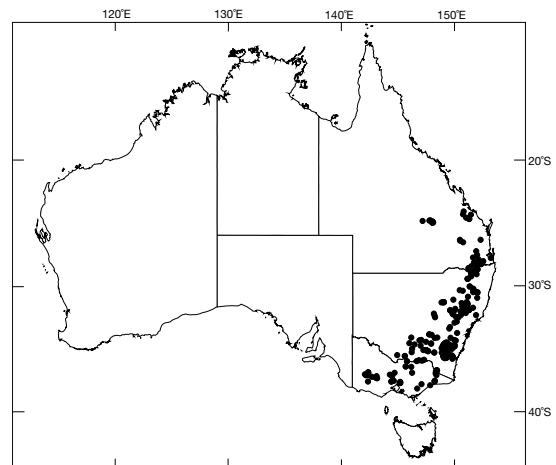
Related species: Yellow box belongs in series *Melliodorae*, subseries *Leucoxylon* with two other species (Brooker 2000). It is easily distinguished from the other species of the series, red ironbark (*E. sideroxylon* and *E. tricarpa*), based on bark type. The Victorian yellow gum or South Australian blue gum (*E. leucoxylon*) is mostly smooth-barked and has buds in 3s. Yellow box is distinguished from red box (*E. polyanthemos*), which may be co-occurring and belongs in another series, by the yellowish brown rough bark, lanceolate adult leaves, axillary inflorescences and smooth buds lacking a median scar.

Publication: In *Walpers Repert. Bot. Syst.* 2, 924 (1843). Type: Neighbourhood of Bathurst, New South Wales, 23 Nov. 1825, A. Cunningham 57.

Names: Botanical Latin *melleus* (honey), *odora* (sweet or pleasant smell), referring to the nectar. Common probably refers to the colour of the wood and to the box group of eucalypts.

Bark: Rough and persistent on the lower part of the trunk and in varying amounts over the upper part and main branches, but occasionally shed in irregular scales or strips to ground level, usually yellow-brown, more rarely grey, subbrous and friable, but becoming darker, harder and coarser with age.

Leaves: Seedling opposite for a few pairs then alternate, petiolate, elliptical, 4–8 × 1.5–5 cm, green or greyish green,



slightly discoloured. Juvenile alternate, petiolate, elliptical to ovate, 5–11 × 3.5–5 cm, green or greyish green, concolorous. Intermediate alternate, petiolate, lanceolate to narrow-lanceolate, c. 11 × 0.5 cm, dull green to dull grey-green, concolorous. Adult alternate, petiolate, lanceolate to narrow-lanceolate, 6.5–13.5 × 0.8–1.8 cm, green, greyish green or slate grey, concolorous. At all leaf stages the intramarginal vein is conspicuously remote from the leaf edge.

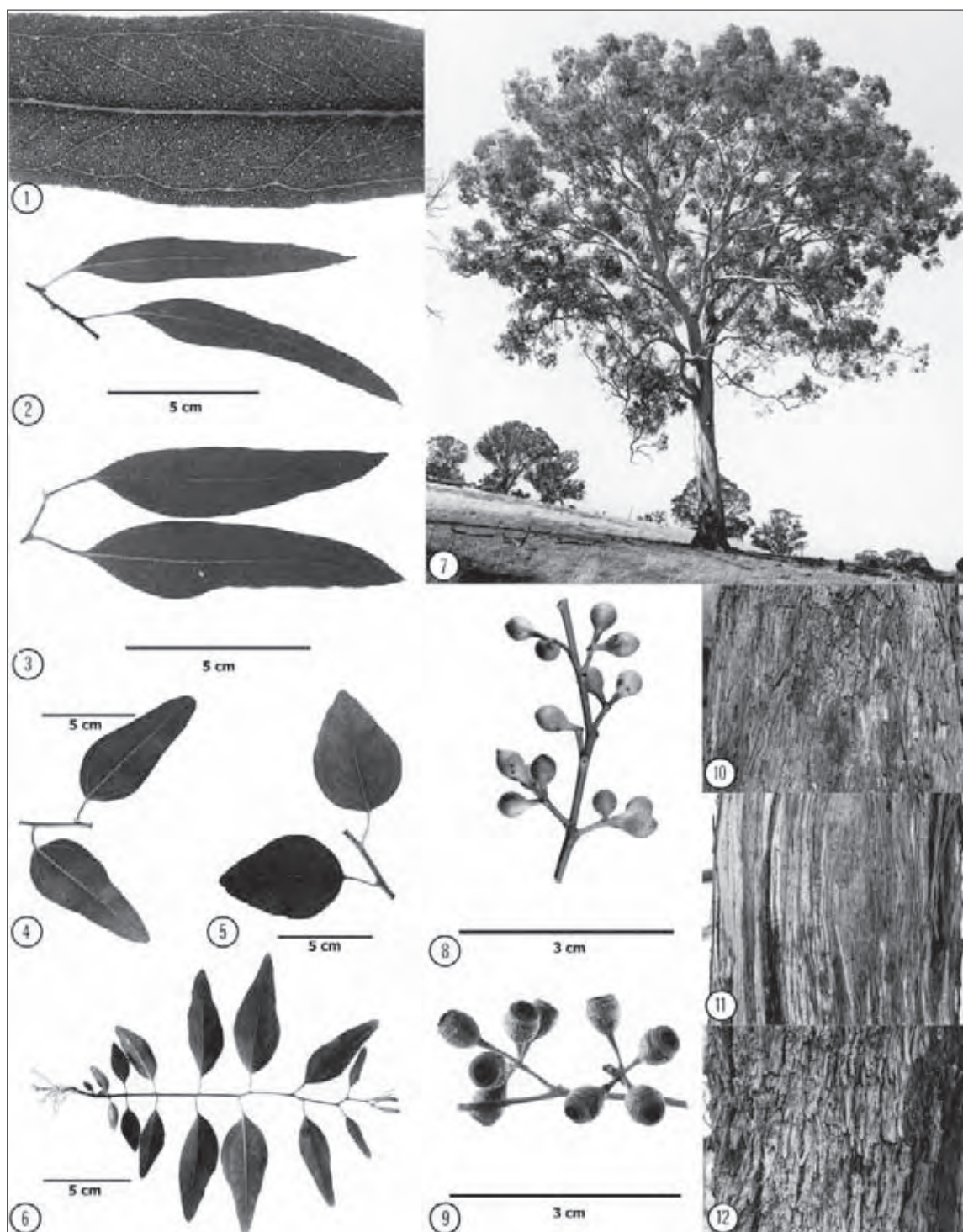
Inflorescences: Mostly simple, axillary but some terminal panicles, inflorescences 7-flowered; peduncles more or less terete to angular, 0.3–1.1 cm long; pedicels angular, 0.2–0.9 cm long; buds clavate or ovoid, 0.5–0.8 × 0.3–0.4 cm; opercula conical to beaked, occasionally almost hemispherical. Flowers Sept.–Feb. and is regarded as one of the best honey producers in the genus.

Fruits: Pedicellate, ovoid, hemispherical, truncate-globose, 0.4–0.7 × 0.4–0.7 cm; disc descending, often obscured by staminal ring; valves usually 5, about rim level or enclosed. Seeds ovoid, slightly compressed, brown, reddish brown or grey, hilum ventral.

Wood: Sapwood resistant to attack by *Lyctus* borers; heartwood light pink or yellowish brown with a fine texture and interlocked grain, very hard, heavy, strong, extremely durable and termite resistant; density 910–1220 kg m⁻³; used for heavy engineering construction, poles, railway sleepers, fencing and is an excellent firewood.

Climate: Altitudinal range: 40–1180 m; Hottest/coldest months: 25–32°C/–2–8°C; Frost incidence: moderate to high (5–60 each year at higher elevations); Rainfall: 450–1400 mm per year, winter max. to uniform to summer max, depending on distribution.

Distinctive features: A medium-sized to tall tree with persistent rough bark variable, irregularly brous, usually yellow-brown and somewhat thin, but becoming thick, shaggy and darker with age; juvenile leaves petiolate, greyish green, elliptical; intramarginal vein remote from leaf edge at all leaf stages; buds with outer opercula held till flowering (no scar); stamens strongly inflexed, outer staminal filaments barren (staminodes); prominent, black, usually deciduous staminal ring on the fruits; valves usually 5.



Eucalyptus melliodora 1. Adult leaf venation 2. Adult leaves 3. Intermediate leaves 4, 5. Juvenile leaves 6. Seedling 7. Tree, Cotter Road, west of Canberra, A.C.T. 8. Buds 9. Fruits 10–12. Bark

Red Ironbark *Mugga, Mugga Ironbark*

Eucalyptus sideroxylon Cunn. ex Woolls and *E. tricarpa* (L.A.S. Johnson) L.A.S. Johnson & K.D. Hill

Red ironbark is a small to medium-sized woodland tree, commonly 10–25 m in height and up to 1 m or more dbh. The form of the trunk is often rather poor, while the bole does not usually exceed half the tree height. *E. tricarpa*, a species of open forests, is of better form and attains 25–35 m in height.

E. sideroxylon extends from near Wangaratta in northern Victoria through the western slopes of New South Wales extending to the western plains, with some more easterly occurrences near Sydney and the Hunter Valley, to south-eastern Queensland, mainly to north of Tara but with isolated occurrences south of the Carnarvon Range, Waaje, Wondai State Forest, Yarraman and Goombungee. *E. tricarpa* occurs in southern New South Wales and is common in the Bendigo goldfields area, Gippsland and central Victoria, extending south to Anglesea.

In Victoria the red ironbarks occur mainly on the hilly and undulating country, while in New South Wales *E. sideroxylon* extends to gentle slopes and the western plains. They are typically found on poor, shallow soils, including sands, gravels, ironstones and clays.

Red ironbarks are woodland and open forest species usually associated with many other eucalypts and cypress pines (*Callitris* spp.). Common associated species for *E. sideroxylon* include boxes and ironbarks (*E. polyanthemo*, *E. microcarpa*, *E. melliodora*, *E. fibrosa* subsp. *fibrosa*) and Dwyer's red gum (*E. dwyeri*). For *E. tricarpa* they include woollybutt (*E. longifolia*), stringybarks (*E. muelleriana*, *E. globoidea*, *E. agglomerata*), mountain grey gum (*E. cypellocarpa*) and coast grey box (*E. bosistoana*).

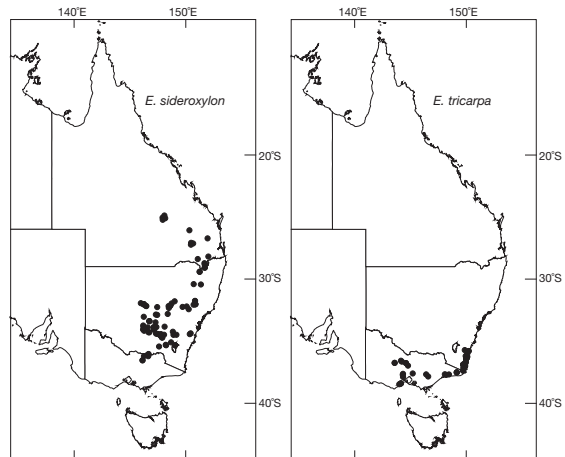
Related species: Brooker (2000) placed red ironbark in the series *Melliodorae*, subseries *Solidae*. Its ironbark distinguishes it from the other subseries whose species are mostly smooth (*E. leucoxylon*) or box-barked (*E. melliodora*). Rule (2005) published *E. tricarpa* subsp. *decora* to account for the prominently pruinose forms south of St Arnaud, but the trees are variable in this character.

Publication: *E. sideroxylon*, *Proc. Linn. Soc. N.S.W.* 11, 859 (1887). Type: near Mt. Caley, Lachlan River, New South Wales, 3 June 1817, A. Cunningham 205. *E. tricarpa*: *Telopea* 4, 247 (1991). Type: Tilba Tilba to Wallaga Lake, New South Wales, 20 Nov. 1950, L.A.S. Johnson.

Names: Botanical Greek *sideros* (iron), *xylon* (wood), refers to the hardness of the wood, although not the hardest in the genus; Greek *tri* (three), *carpos* (fruit), refers to the 3-flowered inflorescences. Common refers to the wood colour.

Bark: Ironbark, persistent to the small branches, hard, ridged and deeply furrowed, dark brown to black, impregnated with kino deposits; smaller branchlets smooth, light grey.

Leaves: Seedling opposite for a few pairs then alternate, petiolate, lanceolate to narrow-lanceolate or linear, 4.5–10 × 0.5–1.3 cm (*sideroxylon*), lanceolate to ovate, 4–9.5 × 1.5–4 cm (*tricarpa*), green or greyish green slightly discolourous. Juvenile alternate, petiolate, lanceolate to linear, 10–15 ×



0.7–2 cm (*sideroxylon*), lanceolate to ovate, 9.5–17 × 3–5 cm (*tricarpa*), green or greyish green, concolorous. Intermediate alternate, petiolate, lanceolate, 9.5–18 × 2.2–3.2 cm, green, greyish green or bluish (*sideroxylon*), 11–21 × 2–3.5 cm, green (*tricarpa*), concolorous. Adult alternate, petiolate, lanceolate or narrow-lanceolate, 7–14 × 1.2–1.8 cm, green, greyish green or bluish (*sideroxylon*), 9.5–22 × 1–2 cm, green (*tricarpa*), concolorous.

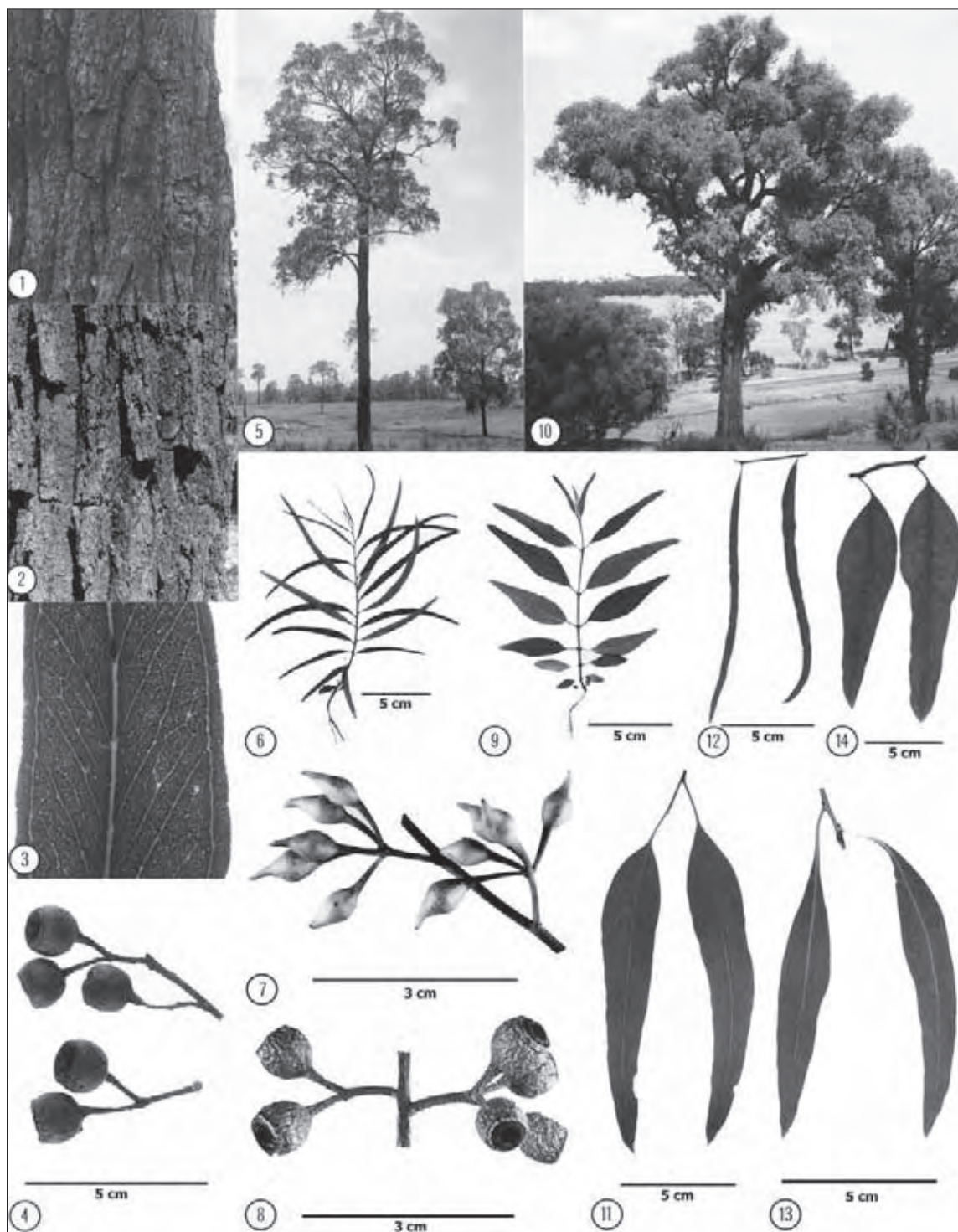
Inflorescences: Simple, axillary, 7 (9) (*sideroxylon*), 3-flowered (*tricarpa*); peduncles angular, 0.5–2 cm long; pedicels angular, 0.2–1.8 cm long, angles often continuing as faint ribs on hypanthia; buds more or less ovoid, 0.7–1.7 × 0.4–0.8 cm; opercula conical to rostrate. The flowers of *E. sideroxylon* may be white, pink, red or pale yellow and those of *E. tricarpa* are usually white but sometimes pink; outer staminal filaments are staminodes. Flowers May–Oct.

Fruits: Pedicellate, ovoid, truncate-globose or urceolate, 0.5–1 × 0.6–1 cm (*sideroxylon*) or truncate-globose, 0.9–1.4 × 0.9–1.4 cm (*tricarpa*), disc relatively broad, descending, often obscured by a persistent staminal ring; valves 5 (*sideroxylon*) or commonly 6 (*tricarpa*), deeply enclosed. Seeds ovoid or compressed-ovoid, brown or grey, hilum ventral.

Wood: Sapwood yellowish, susceptible to attack by *Lyctus* borers; heartwood dark red with moderately fine texture and interlocked grain, very hard, strong, extremely durable and termite resistant; density 910–1220 kg m⁻³; used for heavy engineering construction and for railway sleepers.

Climate: Altitudinal range: near sea level to 1000 m (*sideroxylon*), 20–360 m (*tricarpa*); Hottest/coldest months: 26–32°C/1–3°C (*sideroxylon*), 24–28°C/2–4°C (*tricarpa*); Frost incidence: moderate to high (*sideroxylon*), low to moderate (*tricarpa*), with few to around 40 each year; Rainfall: 450–920 mm per year, uniform to summer max. (*sideroxylon*), 550–1000 mm per year, winter to uniform (*tricarpa*).

Distinctive features: Ironbark trees with black bark, pendent buds and fruits, persistent outer opercula, often pink flowers, staminodes and persistent staminal ring.



Eucalyptus sideroxylon (s), *E. tricarpa* (t) 1, 2. Bark (s) 3. Adult leaf venation (s) 4. Fruits (t) 5. Trees (t) 6. Seedling (s) 7. Buds (s) 8. Fruits (s) 9. Seedling (t) 10. Trees (s) 11. Intermediate leaves (s) 12. Juvenile leaves (s) 13. Adult leaves (s) 14. Juvenile leaves (t)

Yellow Gum (Vic.) or Blue Gum (S.A.) Water gum (Eyre Peninsula, S.A.)

Eucalyptus leucoxylon F. Muell.

This species typically comprises trees 10–16 m tall and up to 0.6 m dbh, but in higher rainfall regions they can be 25–30 m tall with dbh up to 0.8 m. On drier sites it occurs as a mallee only 2–6 m tall. Five infraspecific taxa are recognised here.

Subsp. *leucoxylon* occurs in the south-east of South Australia, on Kangaroo Island, in the Mt Lofty Range, the northern wheatlands and ranges and southern Flinders Ranges. In Victoria it occurs south of the Little Desert through central Victoria to north-east of Melbourne and south to the Brisbane Range. Subsp. *megalocarpa* occurs along coastal sites south of Mt Gambier in South Australia to near Nelson in Victoria. Subsp. *petiolaris* occurs on Eyre Peninsula, north from near Port Lincoln to the Cleve Hills. Subsp. *pruinosa* has disjunct occurrences in the northern Mt Lofty–southern Flinders Ranges and in the Bordertown–Kingston region of South Australia extending east to near Melbourne in Victoria. Subsp. *stephaniae* occurs in the mallee region of South Australia from Meningie east to Mt Arapiles in Victoria.

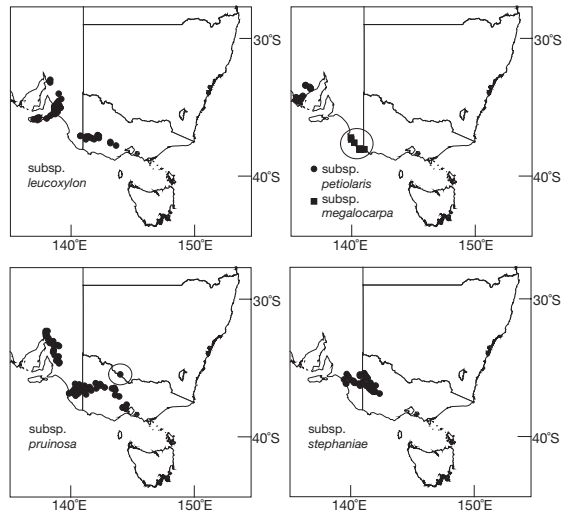
These taxa are found on a range of sites from rocky undulating hills and plains to along creek banks. Soils include clays, sandy loams and sands and parent rocks include shales, granites, quartzites and basalts. Subsp. *megalocarpa* grows on calcareous marine debris and siliceous sands derived from limestone.

Woodlands, open forests and tall shrublands are common structural types and a range of eucalypts may occur as associates (including *E. macrorhyncha*, *E. tricarpa* and *E. largiflorens* in Victoria and *E. camaldulensis*, *E. cladocalyx*, *E. fasciculosa* and *E. odorata* in South Australia).

Related species: Brooker (2000) placed *E. leucoxylon* the series *Meliiodora*, subseries *Leucoxylon*. Being largely smooth-barked, it is easily distinguished from the ironbarks (*E. sideroxylon* and *E. tricarpa*). Yellow box (*E. melliodora*) is readily distinguished from *E. leucoxylon* by its 7-budded inflorescences. Subsp. *bellarinensis* (Rule 1991) and subsp. *connata* (Rule 1998) are minor variants of subsp. *pruinosa*.

Publication: *E. leucoxylon*: *Trans. Vic. Inst. Adv. Sci.* 1, 33 (1855). Type: In the valley of the Mt Lofty Range, South Australia, Nov. 1849, F. von Mueller. Subsp. *megalocarpa* Boland: *Aust. For. Res.* 9, 68 (1979). Type: Dingley Dell, Port MacDonnell, S.A., 1 May 1970, D.J. Boland 158. Subsp. *petiolaris* Boland: *Aust. For. Res.* 9, 70 (1979). Type: Pillaworta Creek near Pillaworta Hill, South Australia, 15 May 1971, D.J. Boland 690. Subsp. *pruinosa* (F. Muell. ex Miq.) Boland: *Aust. For. Res.* 9, 68 (1979). Type: Salt Creek, South Australia, Jan. 1849, F. von Mueller or H. Behr. Subsp. *stephaniae* Rule: *Muelleria* 7, 391 (1991). Type: 9.6 km N of Yanac by road towards Murrayville, 15 May 1985, K. Rule.

Names: Botanical–Greek *leucos* (white), *xylon* (wood); Greek *megalo* (large), *carpos* (fruit), referring to the large fruits; Latin *petiolaris* (petiolate) referring to the juvenile leaves; Latin *pruinosa* (pruinose, white waxy), from the often pruinose buds and fruits; *stephaniae* from the name of the author's daughter. Common–refer to bark colour.



Bark: Usually with 1–2 m of rough, fibrous bark at the base; the smooth bark is mottled with streaks of white, yellow, grey and blue.

Leaves: Seedling–opposite, shortly petiolate for 5–7 pairs before becoming sessile (*leucoxylon*), or all petiolate (*petiolaris*); ovate to suborbicular, 3–7 × 2–6.5 cm, bluish green, discolorous. Juvenile–opposite, sessile (*leucoxylon*) or petiolate (*petiolaris*), ovate or cordate, sometimes connate (*pruinosa*), 7–9 × 5–6.5 cm, bluish green, slightly discolorous. Intermediate–alternate, petiolate, ovate, 7–10 × 2.5–4 cm, green or bluish green, concolorous. Adult–alternate, petiolate, narrow-lanceolate to lanceolate, 9–13 × 1.3–2.5 cm, subcoriaceous, green to bluish green, concolorous.

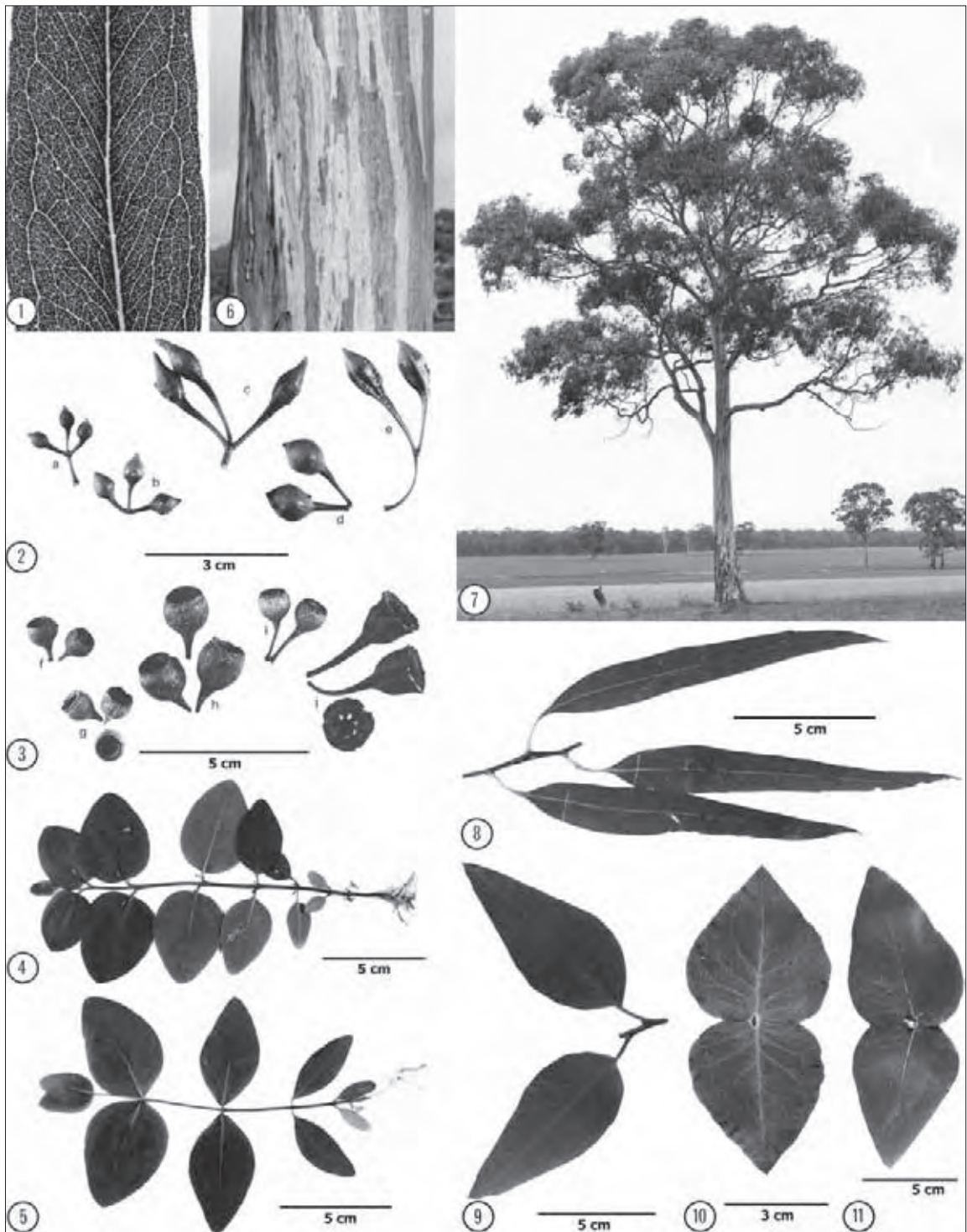
Inflorescences: Simple, axillary, usually 3-flowered; peduncles terete, 0.4–1.1 cm long; buds subglobose to ovoid, 0.6–1.5 × 0.5–0.8 cm; opercula beaked or conical. Flowers May–Sept. and is a very good honey producer.

Fruits: Hemispherical (*leucoxylon*, *pruinosa*), or truncate-globose (coastal populations), or campanulate (*petiolaris*), 0.7–1.2 × 0.8–1.2 cm, smooth but sometimes ribbed (especially *petiolaris*); disc broad, descending, often obscured by deciduous staminal ring; valves 4–6, deeply enclosed. Seeds compressed-ellipsoidal, brown, hilum ventral.

Wood: Sapwood *Lyctus* susceptible, heartwood pale brown, with yellow or pink tints, commonly with interlocked grain, hard, strong, not highly durable but termite resistant; density 760–1215 kg m⁻³; used for structural engineering, fences, railway sleepers, building, framing and poles.

Climate: Altitudinal range: near sea level to 800 m; Hottest/coldest months: 24–29°C/3–10°C; Frost incidence: low to moderate (up to 15 each year at inland sites); Rainfall: 400–800 mm per year, winter max.

Distinctive features: Gum-barked but often with a fibrous stocking to 2 m; 3-flowered inflorescences; outer plamets of flowers are staminodes; white, pink, red, yellow or orange flowers; buds lacking a scar; fruits usually with a prominent staminal ring which is later deciduous.



Eucalyptus leucoxylon: subsp. *leucoxylon* (l), subsp. *megalocarpa* (m), subsp. *petiolaris* (pe), subsp. *pruinosa* (pr), subsp. *sephaniae* (s) 1. Adult leaf venation (l) 2, 3. Buds/Fruits a, b, f, i (pr); c, h (m); d (l); e, j (pe); g (s) 4, 5. Seedlings (pe) 6. Bark 7. Tree (l), near Bendigo, Vic. 8. Adult leaves (l) 9. Intermediate leaves (l) 10. Juvenile leaves (pr) 11. Juvenile leaves (l)

■ The Monotypic Subgenus *Minutifructus* Brooker

Black Ironbox

Eucalyptus raveretiana F. Muell.

Black ironbox is a small to medium-sized, rarely tall tree 12Ð20 (Ð30) m tall and dbh to over 1 m. The bole is usually no more than half tree height which breaks to form a fairly wide, open crown.

This species occurs in subcoastal, central-eastern and northern Queensland from Dipperu National Park south-west of Mackay, northwards and north-west almost to Charters Towers, Bowen and Ayr, also occurring in Rockhampton and westwards and near the Mackenzie River.

Black ironbox prefers sites with moderately fertile loams and light clays with adequate subsoil moisture, which usually occur on river flats or on the edges of rain-forest. Soils are alluvial often with a prominent sandy component. On ridges and hill slopes the soils are usually poorer and may tend to be skeletal, including those derived from sandstones and quartzites.

Black ironbox is an open forest or woodland species and along riverine sites it may occur with coolibah (*E. coolabah*) or forest red gum (*E. tereticornis*), carbeen (*E. tessellaris*), narrow-leaved red ironbark (*E. crebra*), river oak (*Casuarina cunninghamiana*) or various gallery rainforest species. Black ironbox occurs to a limited extent as a minor component in savannah woodland and may be associated with species such as cheesewood (*Nauclea orientalis*).

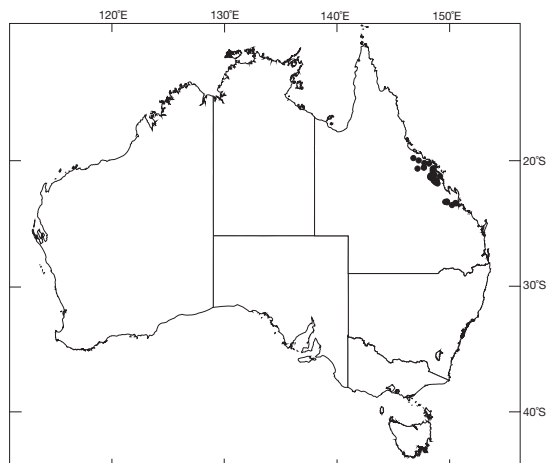
Related species: Black ironbox belongs to a group of three species not closely related to any other eucalypt. Brooker (2000) placed them in subgenus *Minutifructus*, so-named because of the fruits, which are among the smallest in the genus. Howitt's box (*E. howittiana*), also endemic to Queensland, differs by the sessile buds and fruits and the fruits with enclosed valves. Tropical red box (*E. brachyandra*) of the Northern Territory and Kimberley of Western Australia, the other species of the subgenus in Australia, differs by the poorer form and lower stature, thicker, wavy, stringy rough bark, and the cupular fruits with enclosed valves. In habit and habitat, black ironbox may be confused in the field with the unrelated coolibah (*E. coolabah*), which differs by the partly rough-barked boles, the concolorous adult leaves, the adnate anthers usually conical opercula and larger fruits.

Publication: *Frag.* 10, 99 (1877). Type: near Rockhampton, Queensland, P. O'Shanesy.

Names: Botanical honours M.C. Raveret-Wattel (c. 1838Ð1916) of Paris, who was active in the introduction of eucalypts in the Mediterranean region. Common probably from the very hard wood and the bark type.

Bark: Box type on trunk and larger branches, thick, grey over inner brown, upper branches bluish or grey.

Leaves: Seedling opposite for a few pairs, petiolate, ovate, 3.8Ð6.4 × 2.5Ð4 cm, thin, pale green, discolorous. Juvenile subopposite to alternate, petiolate, broadly ovate to suborbicular, 5Ð10 × 2.5Ð5 cm, discolorous. Intermediate alternate, petiolate, ovoid, 6.2Ð7.5 × 3.2Ð4.5 cm, discolorous. Adult alternate, petiolate, narrow-lanceolate to lanceolate or ovate, 7.5Ð15 × 1Ð3 cm, dull green to dark green or bluish green, discolorous.



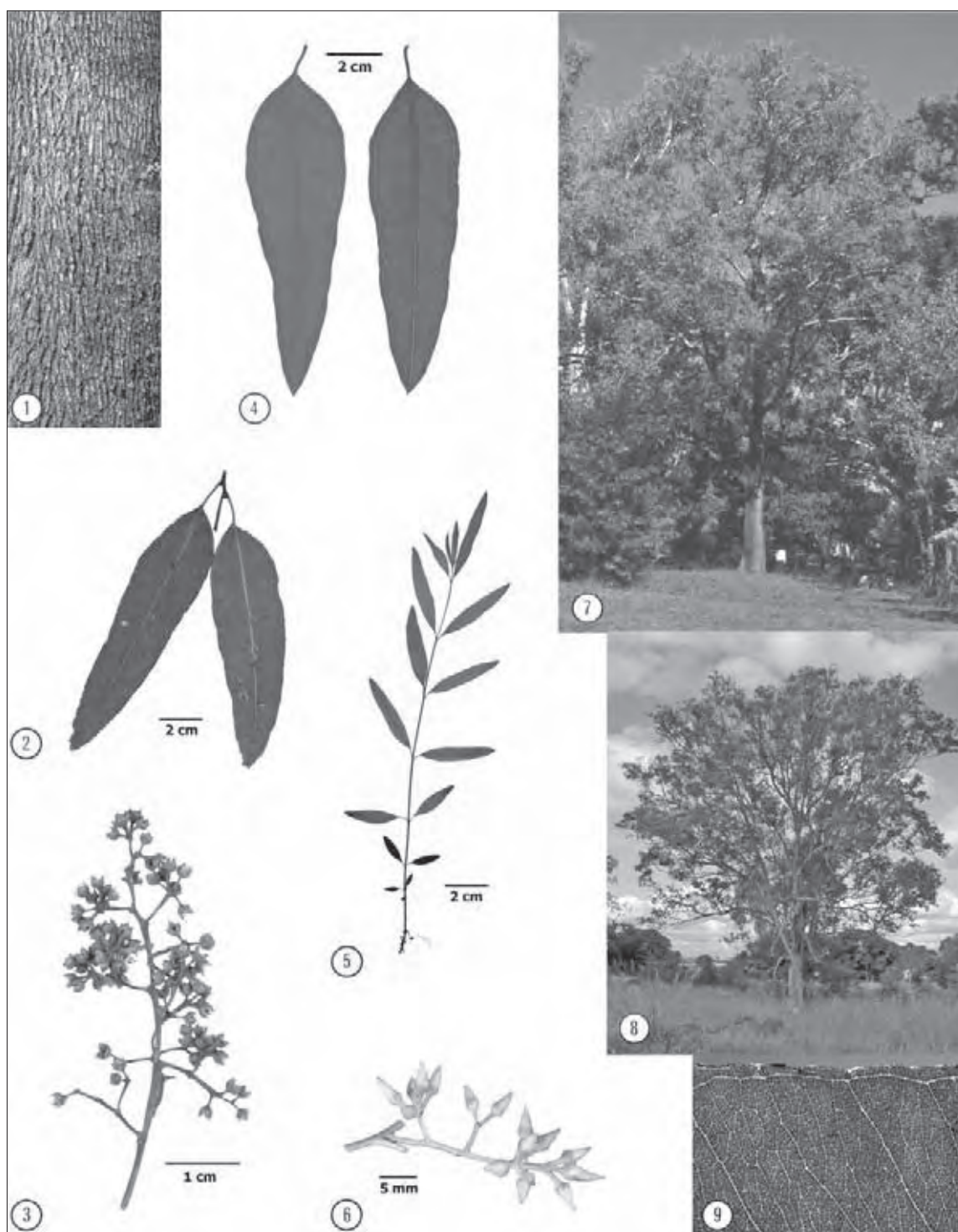
Inflorescences: Terminal panicles, unit inflorescences 7-flowered; peduncles slender, 0.5Ð1 cm long; pedicels to 0.5 cm long, delicate; buds with hemispherical hypanthia and acutely conical opercula, 0.3Ð0.4 × 0.1Ð0.15 cm. Flowers Dec.ÐJan.

Fruits: Tiny, pedicellate, shallowly hemispherical, 0.1Ð0.2 × 0.1Ð0.2 cm; disc obscure; valves 3 or 4, strongly exserted. Seeds ellipsoidal, brown, hilum ventral.

Wood: Dull, dark brownish black, heavy, very hard, very durable, strong but somewhat brittle, density 1090 kg m⁻³, in the past used for railway sleepers, light and heavy construction and split or in the round for fencing.

Climate: Altitudinal range: near sea level to 300 m; Hottest/colest months: 30Ð32°C/8Ð11°C; Frost incidence: low; Rainfall: 650Ð1600 mm per year, summer max.

Distinctive features: Small to medium-sized or rarely tall tree, with rough box type to the larger branches; adult leaves strongly discolorous; terminal panicles; opercula acutely conical; fruits tiny with strongly exserted valves.



Eucalyptus raveretiana 1. Bark 2. Adult leaves 3. Fruits 4. Intermediate leaves 5. Seedling 6. Buds 7, 8. Trees, near Fitzroy River, Rockhampton, Qld 9. Adult leaf venation

■ The Monotypic Subgenus *Alveolata* Brooker

Tallowwood

Eucalyptus microcorys F. Muell.

Tallowwood is a tall to very tall forest tree commonly attaining 35–60 m in height and dbh of 1–2 m (occasionally exceeding 70 m in height and 3 m dbh). The form is generally good with straight, clear boles to two-thirds of the total height.

Tallowwood is widely distributed in northern coastal New South Wales and south-eastern Queensland, between the coast and the higher altitudes of the coastal escarpment of the Great Dividing Range. The limits of its distribution are from near Newcastle in the south to around Maryborough and Fraser Island in the north, with a disjunct western occurrence northwards from Toowoomba.

In the south, tallowwood occurs on slopes and broad ridges, but in the north it tends more to depressions and sheltered valleys. It prefers fertile soils, but will also grow on rather poor sands if subsoil moisture is adequate. Best development is reached in fertile gullies on the margins of rainforest.

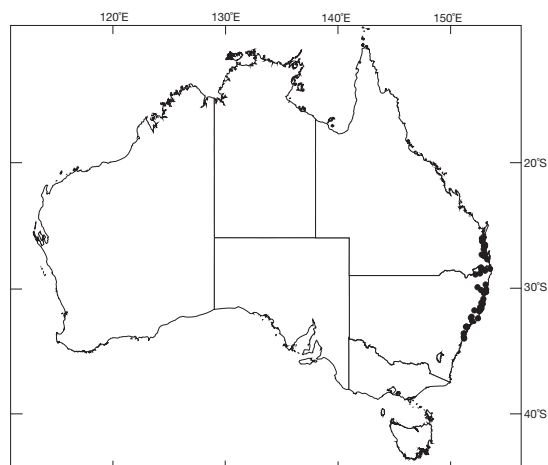
Tallowwood occurs mainly in tall open forests commonly on rainforest fringes. Associated eucalypts include Sydney blue gum (*E. saligna*), blackbutt (*E. pilularis*), flooded gum (*E. grandis*), white mahogany (*E. acmenoides*), silvertop stringybark (*E. laevopinea*), pink bloodwood (*E. intermedia*) and white-topped box (*E. quadrangulata*), with other genera including turpentine (*Syncarpia glomulifera*) and brush box (*Lophostemon confertus*). Where tallowwood occurs in drier forests, associated species include red bloodwood (*E. gummifera*), white stringybark (*E. globoides*) and grey box (*E. moluccana*).

Related species: Maiden (1929) placed tallowwood in the monotypic series *Alveolatae* based on the singularity of the seeds, which are unlike any others in the genus. Brooker (2000) raised the series to subgenus *Alveolata*, as the species is recognised by a number of characters that make it unique in the genus, viz. strongly discoloured adult leaves, terminally clustered axillary inflorescences, minute sepals shed early in bud development, stamens in 4 clusters, reniform anthers, and seeds with a partly honeycombed seedcoat. The bark is reddish brown over inner yellowish brown, and in the field it has the appearance of the unrelated needlebark stringybark (*E. planchoniana*), which is easily distinguished by the broadish, falcate, bluish green adult leaves and the very large ribbed buds and fruits. Based on evidence from DNA markers Steane *et al.* (2002) found that tallowwood was more closely related to species in the subgenera *Symphyomyrtus* and *Minutifructus* (e.g. *E. raveretiana*) than to the monocalypts (subgen. *Eucalyptus*).

Publication: *Fragm.* 2, 50 (1860). Types: Brisbane River, Queensland, F. von Mueller; Hastings and Macleay Rivers, New South Wales, H. Beckler.

Names: Botanical Greek *micros* (small, little), *corys* (helmet, cap), refers to the opercula. Common probably refers to the greasy nature of the heartwood.

Bark: Rough and persistent to the small branches, brown to red-brown, soft, fibrous, often with surface pores and horizontal cracks on underlayers.



Leaves: Seedling Opposite for about 4–6 pairs then alternate, petiolate, ovate, 4.5–7 × 2–3.3 cm, green, discoloured. Juvenile Alternate, petiolate, ovate, 7–11 × 3–5 cm, green, discoloured. Intermediate Alternate, petiolate, ovate to broad-lanceolate, 8.5–15 × 2.5–4 cm, green, discoloured, thin. Adult Alternate, petiolate, lanceolate, tapering to a long point, 8–13 × 1.5–2.5 cm, green, discoloured. All leaves are thin and have slightly crenulate edges.

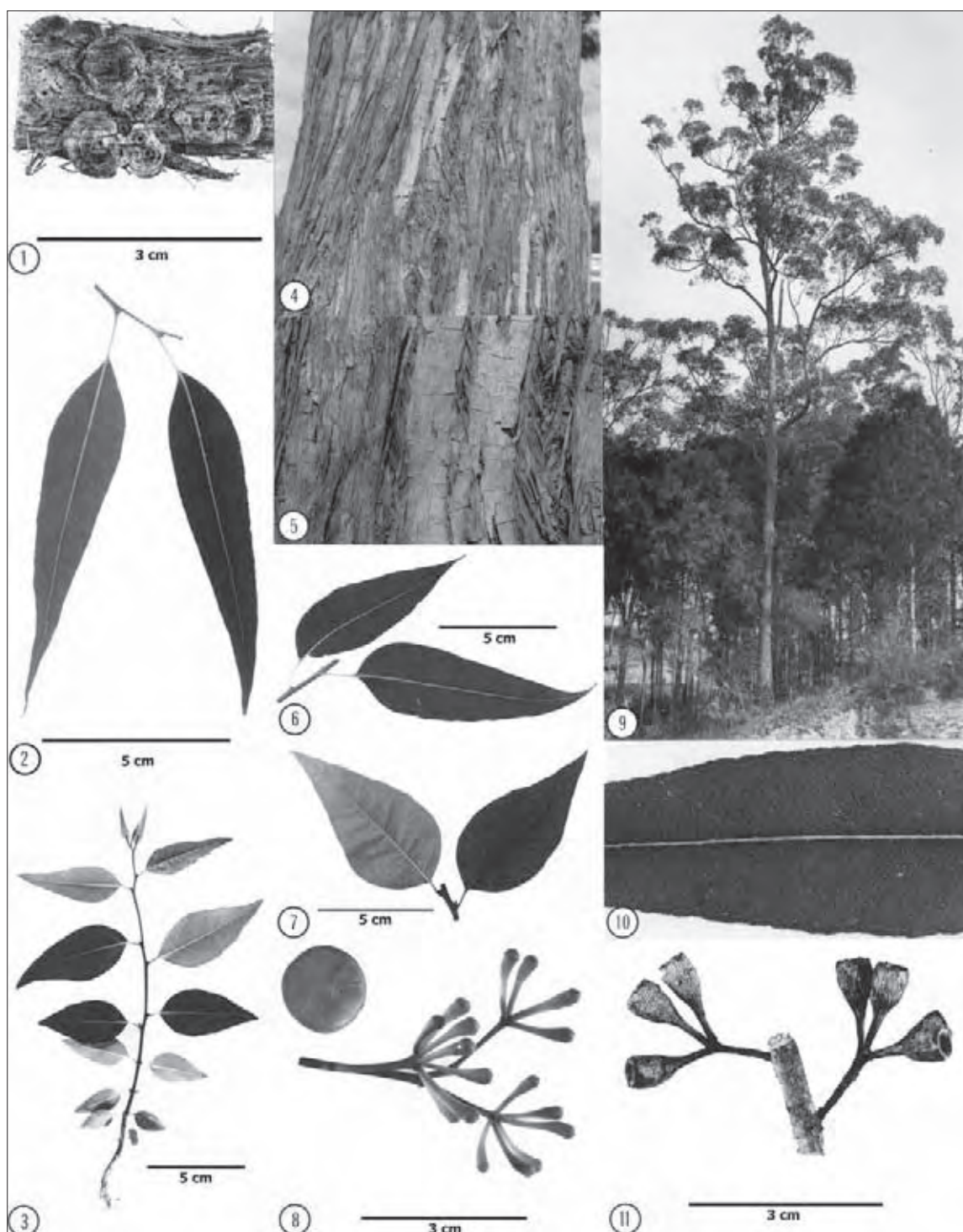
Inflorescences: Simple, axillary inflorescences, usually clustered terminally on the branches, 7(9)-flowered; peduncles flattened, 0.6–1.8 cm long; pedicels more or less angular (though often not really distinct at bud stage due to gradual tapering into hypanthium), 0.2–0.7 cm long, the angles often continuing as faint ribs along the hypanthia; buds clavate, 0.4–0.6 × 0.2–0.3 cm; opercula hemispherical with conspicuous cross sutures formed by the fusion of the petals; Plaments in 4 clusters. Flowers Aug.–Dec.

Fruits: Pedicellate, obconical, 0.4–1 × 0.3–0.6 cm, sometimes with faint ribs continuing from angular pedicels; disc of moderate width, steeply descending; valves 3(4), broad based, with valve tips varying from slightly exerted to slightly enclosed. Seeds ellipsoidal, yellow-brown, honeycombed, hilum ventral.

Wood: Sapwood pale yellowish brown, susceptible to attack by *Lyctus* borers; heartwood yellowish brown with a somewhat greenish tinge, of moderately coarse texture, grain usually interlocked with stripe figure, has a greasy nature which makes gluing difficult, hard, very strong, extremely durable; density 875–1065 kg m⁻³, used for heavy engineering construction, railway sleepers, poles, cross-arms, sills, excellent flooring and decking timber. It is considered one of the best native hardwood timbers in New South Wales.

Climate: Altitudinal range: near sea level to 750 m; Hottest/coldest months: 24–30°C/0–9°C; Frost incidence: low to moderate (up to 60 each year at inland sites); Rainfall: 1000–1850 mm per year, summer max.

Distinctive features: Tall to very tall tree with soft, fibrous, reddish brown bark persistent to small branches, often with surface cracks and pores on underlayers and small volcano-like structures on the surface; all leaves thin, discoloured, somewhat crenulate; opercula with conspicuous cross sutures; fruits obconical with 3 valves.



Eucalyptus microcorys 1. Bark, showing small 'volcanoes' 2. Adult leaves 3. Seedling 4, 5. Bark 6. Intermediate leaves 7. Juvenile leaves 8. Buds (inset shows top of an operculum) 9. Tree, near Murwillumbah, N.S.W. 10. Adult leaf venation 11. Fruits

Gympie Messmate Messmate, Dead Finish

Eucalyptus cloeziana F. Muell.

Gympie messmate reaches its best development in southern Queensland, particularly in the Gympie area, where it attains 55 m in height, around 2 m dbh and has excellent stem form. Elsewhere it varies depending on the habitat from a small crooked tree less than 10 m tall to a larger tree 20–35 m of variable form.

Gympie messmate occurs in a number of locations in eastern Queensland from near Gympie in the south-east, with extensive occurrences from Mundubbera to west of Springsure, and a few isolated occurrences northwards to west of Townsville. It has discontinuous occurrences north of the Townsville region to west of Cooktown.

This species attains best development on metasediments or loams of volcanic origin usually of moderate depth. Elsewhere it occurs on shallow soils over coarse sandstone or on shallow to moderately deep coarse-textured soils derived from granite. The soils are generally well drained, acidic and of low to moderate fertility.

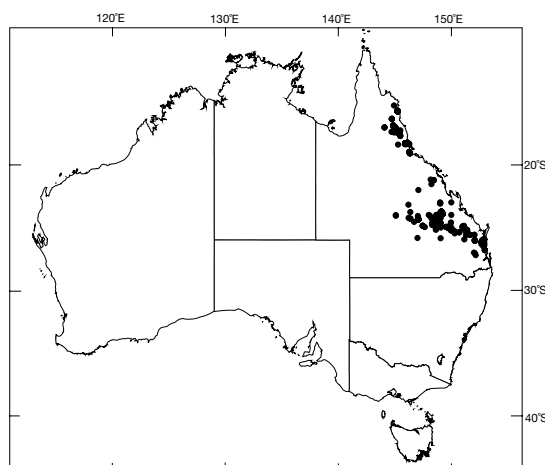
In the Gympie, Cardwell and Ravenshoe areas this species occurs in tall open forests while elsewhere it is found in open forests or woodlands. It is frequently the dominant species in the stand but some of the more commonly associated tree species include lemon-scented gum (*E. citriodora*), narrow-leaved red ironbark (*E. crebra*), white mahogany (*E. acmenoides*), red mahogany (*E. resinifera*), pink bloodwood (*E. intermedia*), flooded gum (*E. grandis*), turpentine (*Syncarpia glomulifera*), brush box (*Lophostemon confertus*), smooth-barked apple (*Angophora costata* subsp. *leiocarpa*) and forest oak (*Allocasuarina torulosa*).

Related species: Brooker (2000) followed the informal treatment of Pryor and Johnson (1971) and placed this species in the monospecific subgenus *Idiogenes*. Gympie messmate is not considered closely related to any other species in the genus. Stokoe *et al.* (2001) verified hybrids between Gympie messmate and white mahogany (*E. acmenoides*) from subgenus *Eucalyptus*, using molecular markers. This is the first interspecific hybrid documented between the subgenera in *Eucalyptus* that were erected by Pryor and Johnson (1971).

Publication: *Fragm.* 11, 44 (1878). Type: Coastal mountains near Rockingham Bay (Cardwell district), Queensland, 22 Dec. 1867, J. Dallachy.

Names: Botanical honours the French chemist F.S. Cloez (1817–1883), who had an interest in the essential oils distilled from eucalypt leaves. Common refers to the Gympie area, while messmate is a word of uncertain origin applied to a number of rough-barked trees.

Bark: Persistent on the trunk and sometimes on larger branches, brown or yellow-brown, soft, flaky-porous, with fine or coarse longitudinal fissures, or often distinctly tessellated; smaller branches smooth, greyish white or yellowish. The extent of rough bark is variable; trees in the Gympie region have rough bark to the larger branches, elsewhere trees are more or less half-barked.



Leaves: Seedling opposite and sessile or shortly petiolate for about 5–9 pairs, then alternate and petiolate, elliptical to ovate, 6–10 × 2–5 cm, greyish green, discolorous. Juvenile alternate, petiolate, ovate or broad-lanceolate, 9–15 × 2.5–7 cm, green, discolorous. Intermediate alternate, petiolate, broad-lanceolate, 10–15 × 3–4 cm, green, discolorous. Adult alternate, petiolate, lanceolate to narrow-lanceolate, 8–13 × 1–3 cm, green, discolorous.

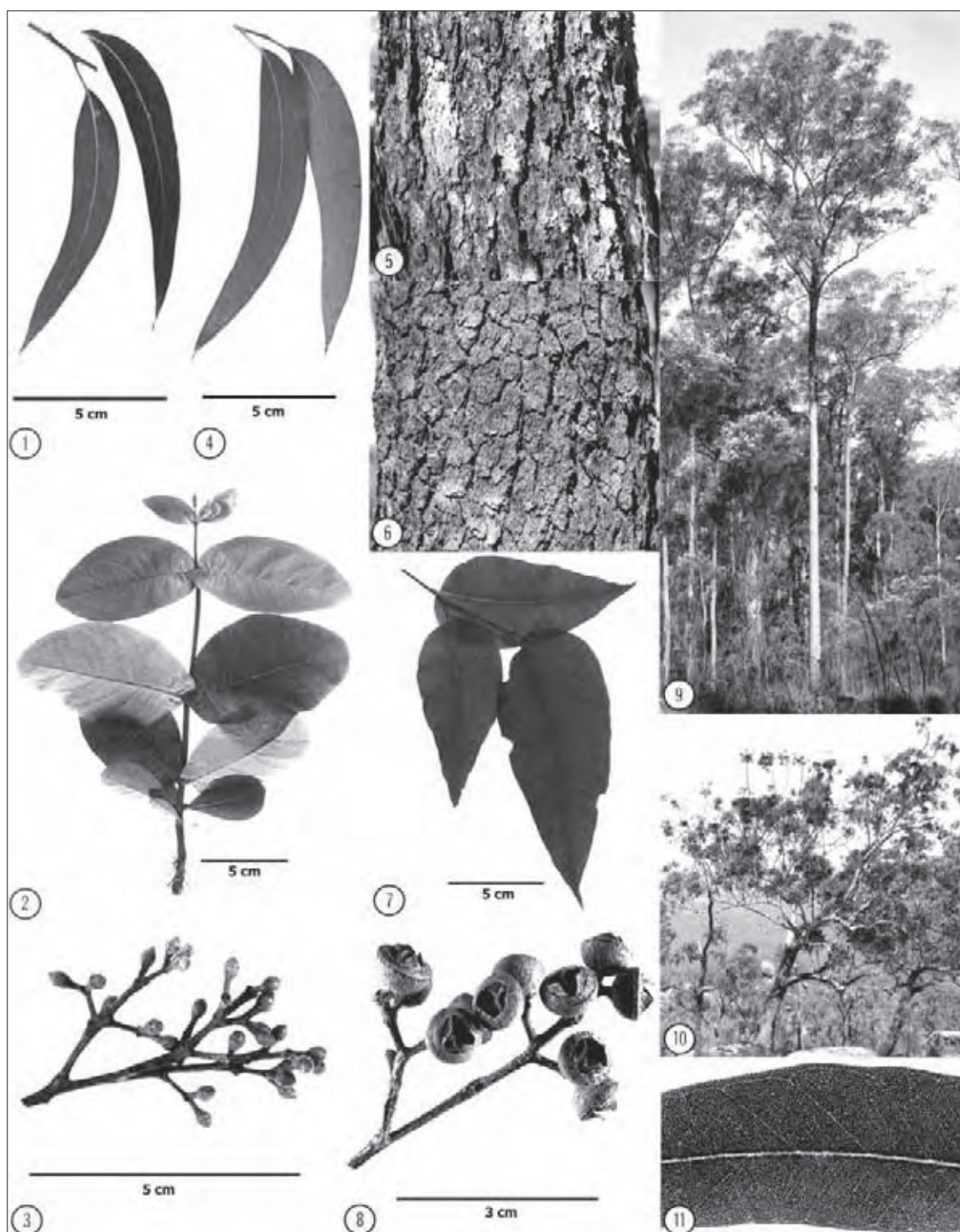
Inflorescences: Compound, axillary, unit inflorescences 7-flowered; sepals shed early; peduncles terete or slightly angular, 0.5–1 cm long; pedicels 0.1–0.4 cm long; buds ovoid to clavate, 0.4–0.7 × 0.3–0.4 cm; opercula hemispherical. Flowers Nov.–Feb.

Fruits: Shortly pedicellate, hemispherical to globose, 0.5–1 × 0.6–1.2 cm; disc generally broad and slightly ascending (but sometimes narrow, almost obscure); valves 3 or 4, to rim level or slightly exserted. Seeds cuboid or elongated, yellow-brown, hilum terminal.

Wood: Sapwood not susceptible to attack by *Lyctus* borers; heartwood yellowish brown, strong, hard, extremely durable and termite resistant; density 855–1140 kg m⁻³; used for heavy engineering construction, railway sleepers, mine timber, posts, poles and scantling.

Climate: Altitudinal range: 40–1000 m; Hottest/coldest months: 29–34°C/5–18°C; Frost incidence: low (up to 5 each year at inland sites); Rainfall: 550–2300 mm per year, summer max.

Distinctive features: A tree, very variable in height, habit, morphological characteristics and habitat, though not easily confused with any other eucalypt species; leaves at all stages are discolorous; upper limbs smooth-barked; inflorescences axillary, compound; yellow-brown seed, not easily distinguishable from the chaff (unfertilised ovules).



Eucalyptus cloeziana 1. Adult leaves 2. Seedling 3. Buds 4. Intermediate leaves 5, 6. Bark 7. Juvenile leaves 8. Fruits 9. Tree, near Gympie, Qld 10. Tree, west of Mt Carbine, Qld 11. Adult leaf venation

False Mahogany

Eucalyptus rubiginosa Brooker

False mahogany is a small to medium-sized tree up to 20 m tall. It usually branches at below or about half tree height to form a crown of dull, dark green leaves with terminal inflorescences conspicuous on the outside of the crown.

This species has a very sporadic natural distribution in south-eastern Queensland. Currently it only known from five disjunct sites: it occurs north-west of Taroom, in Isla Gorge National Park, near Tieren east of Isla Gorge, and north of Chinchilla at Waaje and in the vicinity of Turkey Mountain in Barakula State Forest.

False mahogany commonly grows in hilly rocky sites on skeletal sandy loam soils derived from sandstone.

It occurs in eucalypt woodlands or open forests, and is associated with a diverse range of other eucalypts, including species from most major groups, e.g. Gympie messmate (*E. cloeziana*), white mahogany (*E. acmenoides*), Bailey's stringybark *E. baileyana*), brown bloodwood (*E. trachyphloia*), carbeen (*E. tessellaris*), narrow-leaved white mahogany (*E. tenuipes*), narrow-leaved red ironbark (*E. crebra*) and smooth-barked apple (*Angophora costata*), which all occur at Isla Gorge National Park. The most commonly recorded associate is often large-fruited yellowjacket (*E. watsoniana*).

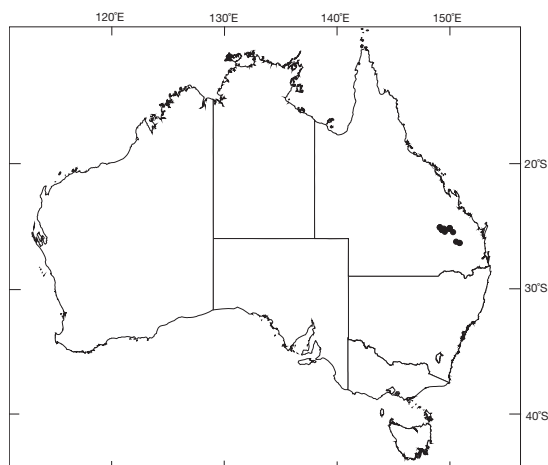
Related species: False mahogany is taxonomically isolated in the genus *Eucalyptus* being the only species in the subgenus *Primitiva* (Brooker 2000). It has affinities with the monocalypts (subgenus *Eucalyptus*), and may be considered basal to them in terms of evolutionary development. It differs from mainstream monocalypts in its primitive characters such as strongly discoloured, densely reticulate adult leaves, inflorescences in terminal panicles (like the quite unrelated bloodwoods, boxes and ironbarks), and the ovule pattern of 4 vertical rows. The monocalypts notably have ovules in 2 rows apart from the 4 rows in some high altitude snow gums, but in these the character may be regarded as a reversal. False mahogany has in common with some monocalypts namely stringy rough bark which is red-brown, similar in colour to needlebark stringybark (*E. planchoniana*) and tallowwood (*E. microcorys*) which are not taxonomically related, and do not co-occur. The species has been confused with white mahoganies with which it shares the dense reticulation of the adult leaves and to some extent the shape of the fruits, but it has narrower juvenile leaves.

Publication: *Austral. For. Res.* 14, 311 (1984). Type: 119 km south of Bauhinia Downs towards Taroom, Queensland, 23 Apr. 1975, M.I.H. Brooker 4840 & D.A. Kleinig.

Names: Botanical Latin *rubiginosus* (rusty red) referring to the colour of the bark. Common name alluding to its apparent affinity to the white mahoganies (before its formal recognition in 1984 it was collected as white mahogany, *E. umbra*).

Bark: Finely stringy, persistent to the small branches, red-brown.

Leaves: Seedling Opposite for about 10 pairs, shortly petiolate, linear to lanceolate, 3–15 × 0.4–2 cm. Juvenile Alternate, shortly petiolate, narrow-lanceolate to lanceolate,



10–15 × 1.5–3 cm, slightly glossy, green, discoloured. Adult Alternate, petiolate, lanceolate or falcate, to 15 × 2 cm, dull dark green, discoloured.

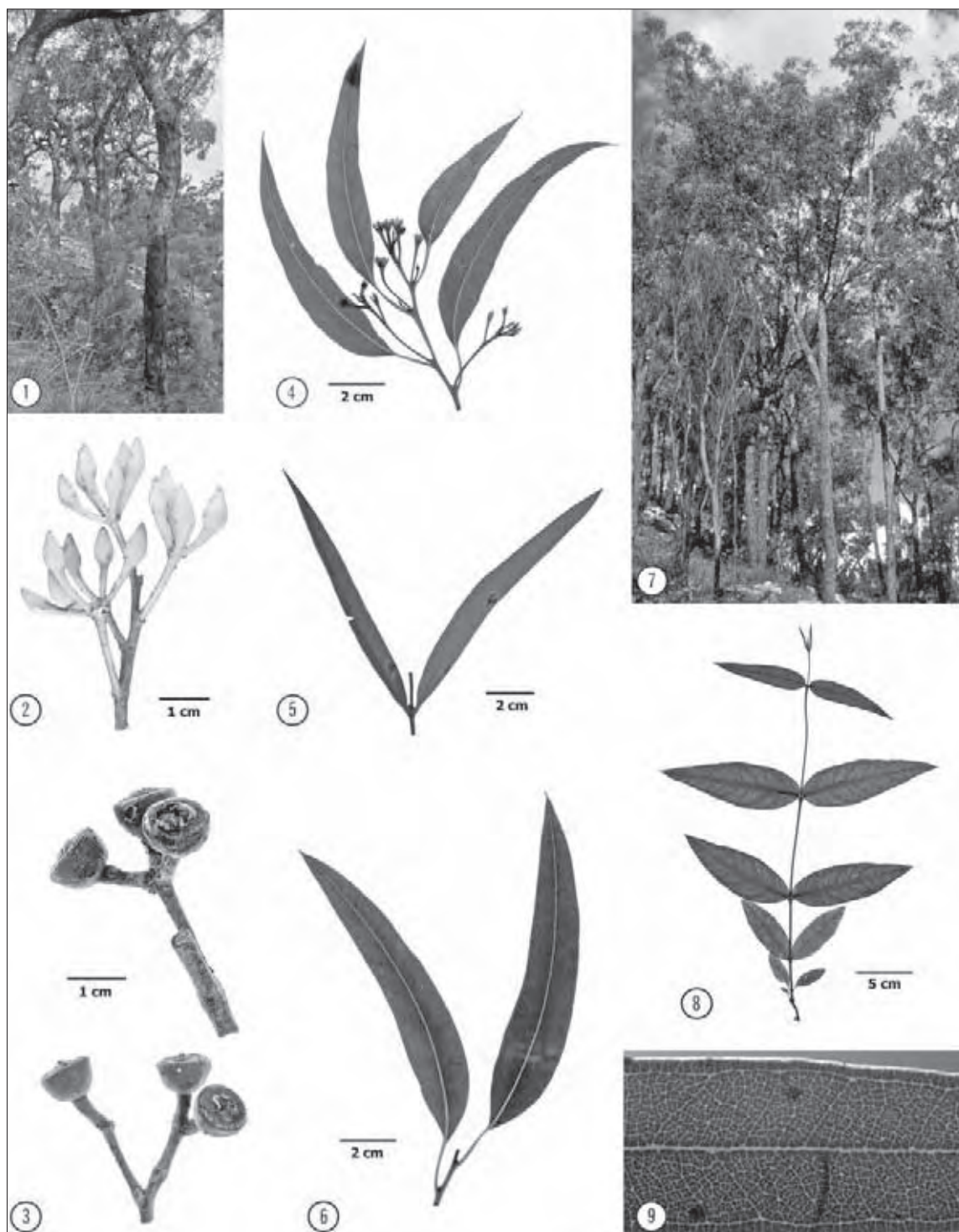
Inflorescences: Terminal panicles, unit inflorescences 7(9)-flowered; peduncles flattened, to 2 cm long; buds on long angular pedicels, clavate, to 1 × 0.5 cm; opercula conical. Flowers Sept.–Nov.

Fruits: Pedicellate, cupular to shallowly campanulate, 0.6–0.9 × 1.2–1.4 cm; disc level to slightly ascending; valves 4, slightly exserted. Seeds compressed-ovoid, brown, hilum ventral.

Wood: Poorly known due to limited availability.

Climate: Altitudinal range: 200–500 m; Hottest/coldest months: 30–32°C/4–5°C; Frost incidence: low; Rainfall: 650–750 mm per year, summer max.

Distinctive features: Small to medium-sized tree, red-brown finely stringy bark to the small branches; adult leaves strongly reticulate, discoloured; inflorescences terminal panicles.



Eucalyptus rubiginosa 1. Stand, Isla Gorge, Qld 2. Buds 3. Fruits 4. Inflorescences developing on a leafy sprig 5. Intermediate leaves 6. Adult leaves 7. Tree, Turkey Mountain, Qld 8. Seedling 9. Adult leaf venation

■ Monocalypts (Tingles, Jarrah, White Mahoganies, Stringybarks, Blackbutts, Ashes, Peppermints)

Eucalyptus subgenus *Eucalyptus* Brooker

This subgenus, previously referred to informally as *Monocalyptus* (Pryor and Johnson 1971), consists of about 110 species and is therefore the second largest subgenus. It includes the first named eucalypt, *E. obliqua*, and many of Australia's most important timber species such as alpine ash (*E. delegatensis*), jarrah (*E. marginata*) and the world's tallest hardwood species, mountain ash (*E. regnans*).

The group is generally confined to wetter areas of south-western, southern and eastern Australia although one species, soap mallee (*E. diversifolia*) links the southern coast from east to west along the very dry country of the Great Australian Bight region. Otherwise, subgenus *Eucalyptus* is completely absent from arid Australia. The subgenus also includes the snow gums (*E. pauciflora*) whose shrubby form, subsp. *niphophila*, grows to about 2000 m altitude and is therefore the highest altitude eucalypt in Australia.

The timber varies from the hard, relatively heavy, red-coloured wood of jarrah to the lighter, pale-coloured wood of the eastern species such as the ashes.

Botany

Botanically, subgenus *Eucalyptus* is distinct in many features from the other subgenera but the association of two characters is usually sufficient to distinguish the group. As the common name, the monocalypts, implies, the buds of the group have only a single operculum. Therefore the external bud tissue is continuous from the hypanthium to the operculum. There is no scar formed by the abscission of an outer operculum although a slight indentation may be present (Fig. 30). When using this character, care must be taken to detect if an apparent scar is formed by the incipient dehiscence of the single opercu-

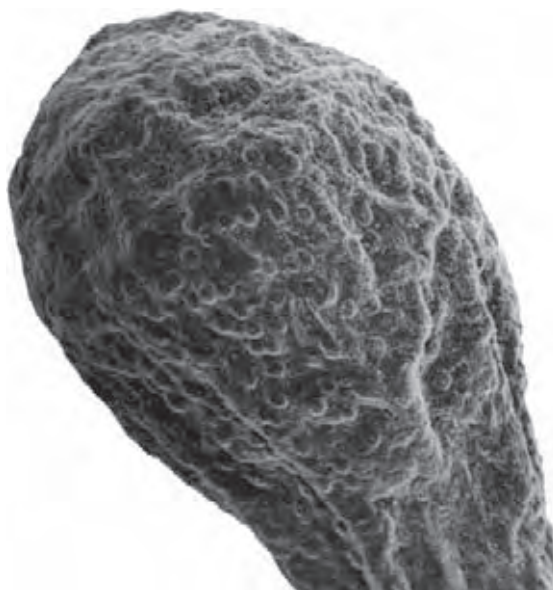


Figure 30. A bud of *E. rossii* (subgenus *Monocalyptus*) showing continuous bud tissue from hypanthium to operculum. (The bud is 2 mm diameter [$\times 25$].)

lum just before flowering. Also a few bi-operculate species of *Symphyomyrtus* hold their outer operculum until flowering, e.g. series *Melliodorae*, and therefore no scar is formed during bud development. A longitudinal section of a bud usually shows whether one or two opercula are present. The second distinguishing feature is the ovule pattern. All subgenus *Eucalyptus* species, except some high altitude snow gums, have 2 contiguous vertical rows of ovules on the placenta (see Fig. 27a). The snow gums referred to have 3 or 4 rows. Some *Eudesmia* species have 2 rows but these are usually not contiguous and all other species in the genus have 4, 6, 8 or 10 rows.

Subgenus *Eucalyptus* has been traditionally called the *Renantherae* after Bentham's (1867) treatment of the genus. The name alludes to the kidney-shaped anthers, which dehisce by oblique, finally confluent slits, in most species (Fig. 31a). However, a small group of basically Western Australian subgenus *Eucalyptus* (subsection *Frutices*), have anthers of approximately similar shape before dehiscence but with non-confluent or scarcely confluent slits (e.g. *E. diversifolia*, Fig. 31b). Four western species of subgenus *Eucalyptus* species (subsection *Arboreae*), viz. *E. brevistylis*,



a)



b)

Figure 31. *Monocalyptus* anthers: (a) anthers of *E. elata* dehiscing by confluent slits [$\times 120$]; (b) anthers of *E. diversifolia* dehiscing by non-confluent slits [$\times 80$].

E. marginata, *E. staeri* and *E. jacksonii*, may have eastern affinities with respect to the anther shape and dehiscence. These share the anther character of dehiscence by confluent slits with all eastern species of this subgenus, however, it is difficult to relate them to eastern species in other characters apart from the reniform cotyledons.

The leaves of eastern subgenus *Eucalyptus* species are notable in the genus for their relatively sparse reticulation except for the white mahoganies, the leaves of which are strongly reticulate.

Subsection *Frutices* comprises mostly mallees including the unique Twin Peak Island mallee (*E. insularis*), which is known only from a granite rock near Cape Le Grand and from 80 km to

the east on North Twin Peak Island in the Recherche Archipelago. While clearly belonging to subgenus *Eucalyptus*, it has no obvious affinity with any other species. The subsection includes only one useful timber tree, bullich (*E. megacarpa*), which also occurs as a mallee.

The eastern species of subgenus *Eucalyptus* fall into fairly distinctive groups, viz. white mahoganies, stringybarks, blackbutts, ashes (which include the snow gums and scribbly gums) and peppermints. These eastern groups are in turn distinguished from each other by the association of several attributes but are most conveniently characterised by the seedlings (Brooker 1977) and the bark.

Bullich

Eucalyptus megacarpa F. Muell.

Bullich varies from a tree up to 30 m in height, with a straight trunk and usually a dense crown to a depauperate tree, shrub or mallee only 2–5 m high.

Bullich is found in a coastal belt, mainly less than 80 km wide in the south-west of Western Australia. It extends from south-east of Perth, south to Cape Leeuwin and east to the Albany region.

The tree form mainly grows in moist situations on silty to sandy loam alluvium edging swamps and on gentle topography along streams and other drainage channels. The smaller form is also found on gentle slopes but these may include the upper slopes of low ranges. The soils include coastal sands, lateritic types, and others derived from granite, shales, gneiss and quartzite.

The tall tree form of bullich typically occurs in open forests, as almost pure stands fringing the edges of damp areas. It sometimes occurs with yarri (*E. patens*) and with several tall eucalypts such as jarrah (*E. marginata*) growing in adjacent forests. Nearer the coast this form grows with karri (*E. diversicolor*) and yate (*E. cornuta*). The shrub or mallee form of bullich is associated with shrubby marri (*E. calophylla*), Swan River peppermint (*Agonis flexuosa*) and grass trees (*Xanthorrhoea* species).

Related species: Brooker (2000) placed bullich in the large subsection *Frutices* in a small series (*Preissianae*), which consists of four distinctive species. The series is notable in Western Australia for the 3-budded inflorescences and large fruits with distinctive lobing of the disc. The lobes are very large in crowned mallee (*E. coronata*), from around east Mount Barren and in Cape Le Grande mallee (*E. aquilina*) and Quagi Beach mallee (*E. preissiana* subsp. *lobata*) both from the Esperance region. These latter taxa differ by the seeds, which are brown in *E. preissiana* and black in *E. aquilina*. Bullich also has black seeds and differs from the two related species by the almost flat top of the fruits, though still lobed to some extent.

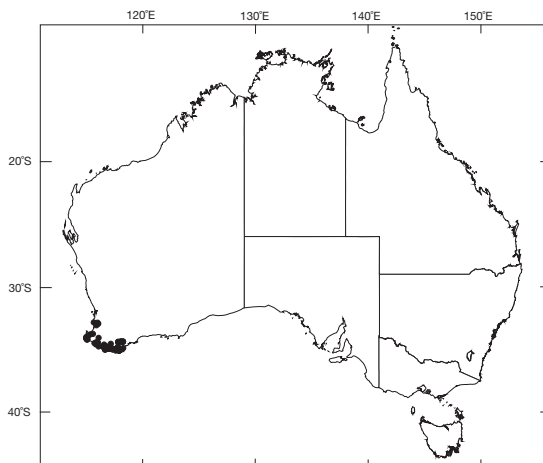
Publication: *Fragm.* 2, 70 (1860). Type: Wilson Inlet, Western Australia, 1858, G. Maxwell.

Names: Botanical: Greek *megas* (large), *carpos* (fruit). Common: of Aboriginal origin.

Bark: Decortivating nearly to ground level, leaving a smooth, alabaster-white or yellowish white surface. Towards the base of the tree there may be small, somewhat thin, elongated plates of outer bark which are retained for a time.

Leaves: Seedling: Opposite, sessile, slightly amplexicaul, broadly ovate, 5–16 × 3–9 cm, green, discolorous. Juvenile: Alternate, petiolate, ovate, 13–18 × 4.5–9 cm, green, discolorous. Intermediate: Alternate, petiolate, broad-lanceolate, 10–17 × 3–4.5 cm, green, nearly concolorous. Adult: Alternate, petiolate, broad-lanceolate or falcate, 8.5–14 × 2–3 cm, dull green, concolorous.

Inflorescences: Simple, axillary, 3-flowered; peduncles strongly flattened, 1–2.6 cm long and up to 0.7 cm wide; buds sessile or very shortly pedicellate, truncate-ovoid to subglobose, 1.8–2.1 × 1.2–1.5 cm; opercula low hemispherical-apiculate or often prominently beaked. Flowers Oct.–Nov.

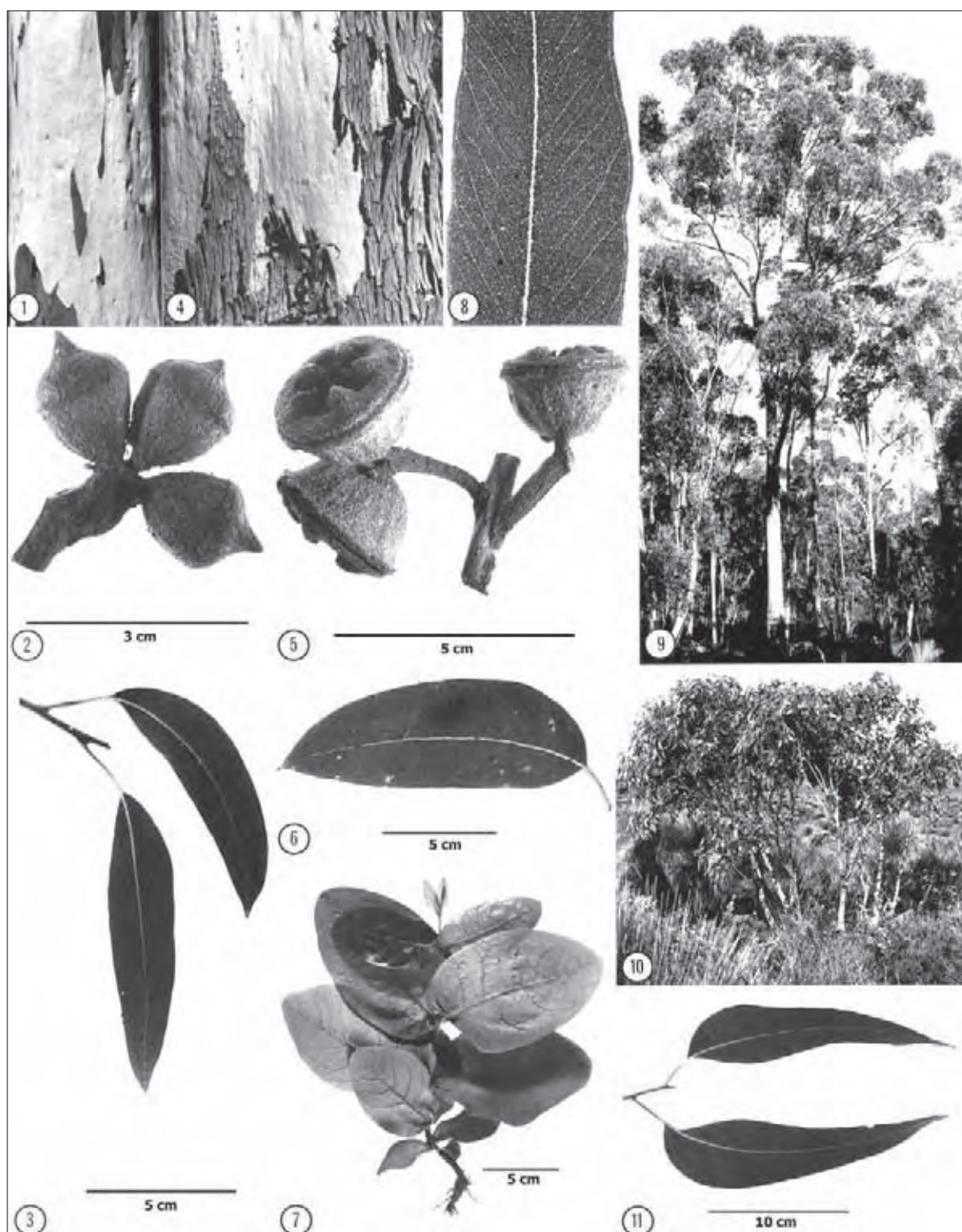


Fruits: Sessile or very shortly pedicellate, obconical to campanulate, 1.6–2.5 × 1.8–2.8 cm; disc very broad with conspicuous, slightly raised lobes almost obscuring the 3–5 valves. The hypanthia may be nearly smooth or marked with faint striations. Seeds pyramidal, shiny black, hilum terminal.

Wood: Heartwood light brown, sometimes pinkish brown, texture intermediate, strong, moderately fissile but subject to kino (gum) veins; density 660–750 kg m⁻³; of limited availability and use.

Climate: Altitudinal range: 100–400 m; Hottest/coldest months: 25–30°C/6–9°C; Frost incidence: low to moderate (up to 10 each year at inland sites); Rainfall: 750–1250 mm per year, winter max.

Distinctive features: A smooth, white-barked tree or a mallee, always with conspicuously large, often curved, pruinose-textured leaves; large buds and fruits in 3s; broad, lobed disc almost obscuring the 3–5 valves.



Eucalyptus megacarpa 1, 4. Bark 2. Buds 3. Adult leaves 5. Fruits 6. Juvenile leaf 7. Seedling 8. Adult leaf venation 9. Tree, W.A. 10. Mallee form, W.A. 11. Intermediate leaves

Yarri Blackbutt, Swan River Blackbutt, Western Australian Blackbutt

Eucalyptus patens Benth.

Yarri may be a tall tree up to 45 m high and with dbh to 1.8 m and a relatively large, straight bole which may be heavily branched in the upper parts. On less favourable, particularly swampy sites, it is a smaller tree of poor form or a mallee.

This species has a natural distribution which coincides closely, although sporadically, with that of jarrah (*E. marginata*), i.e. from between Perth and Toodyay in the northern part of the occurrence to Albany on the south coast, a distance of about 500 km. This area is mainly within 120 km of the sea.

Yarri occurs mainly in valleys and depressions of the Darling Range and to a lesser extent on lowlands and swampy sites towards the coast. On the flatter areas it is found mainly on the deeper, silty to sandy alluvial loams rather than on the laterite. It prefers soils which are moist, but not waterlogged, and with a well-developed clay subsoil.

This species is nowhere plentiful and typically occurs in tall open or open forests on favourable sites throughout the main jarrah (*E. marginata*) belt. Other eucalypts that occur in the area include marri (*E. calophylla*), karri (*E. diversicolor*) and moitch (*E. rudis*).

Related species: Yarri is not closely related to any of the other Western Australian monocalypts. Brooker (2000) placed this species in section *Longistylus*, subsection *Arboreae* and in its own series (*Patentes*). In the jarrah forest it may be confused with jarrah but is distinguished by the thick, furrowed, corky rough bark, the bluish green, curved adult leaves, the conspicuous large juvenile leaves, that usually have attenuated apices (Ödrip-tipsÖ) and by its occurrence on low-lying terrain.

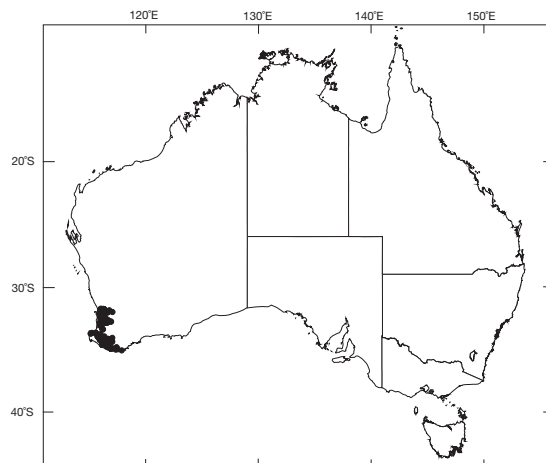
Publication: *Fl. Austral.* 3, 247 (1867). Syntypes: Harvey River, Western Australia, A. Oldfield; Tone River, Western Australia, G. Maxwell; Swan River, Western Australia, J. Drummond 72 (4th collection); south-western Western Australia, J. Gilbert; south-western Western Australia, J.S. Roe; Swan River Colony, Western Australia, 1843, L. Preiss 252.

Names: Botanical Latin *patens* (spreading, outspread) apparently in allusion to the size of the canopy. Common name of Aboriginal origin.

Bark: Rough and persistent to the small branches, thick, corky, friable, deeply and coarsely furrowed longitudinally, with some cross furrows (not in flattish strips like jarrah); greyish outer, yellowish inner.

Leaves: Seedling opposite for many pairs, sessile, ovate, cordate, 8–14 × 4–7 cm, grey-green, discolorous. Juvenile similar to seedling leaves but becoming larger, remaining opposite with long internodes, then becoming alternate, petiolate, ovate, 12–22 × 7–10 cm, narrowing abruptly to form long, P-ne tips (Ödrip-tipsÖ). Intermediate alternate, petiolate, broad-lanceolate, falcate, 15–20 × 3–5 cm, narrowing gradually to a long, P-ne point, green, concolorous. Adult alternate, petiolate, usually falcate, 10–16 × 1.2–3 cm, tapering to a P-ne point, dull, bluish green, concolorous.

Inflorescences: Simple, axillary, 7(11)-flowered; peduncles slightly to distinctly angled, 1–2 cm long; pedicels 0.1–0.4 cm



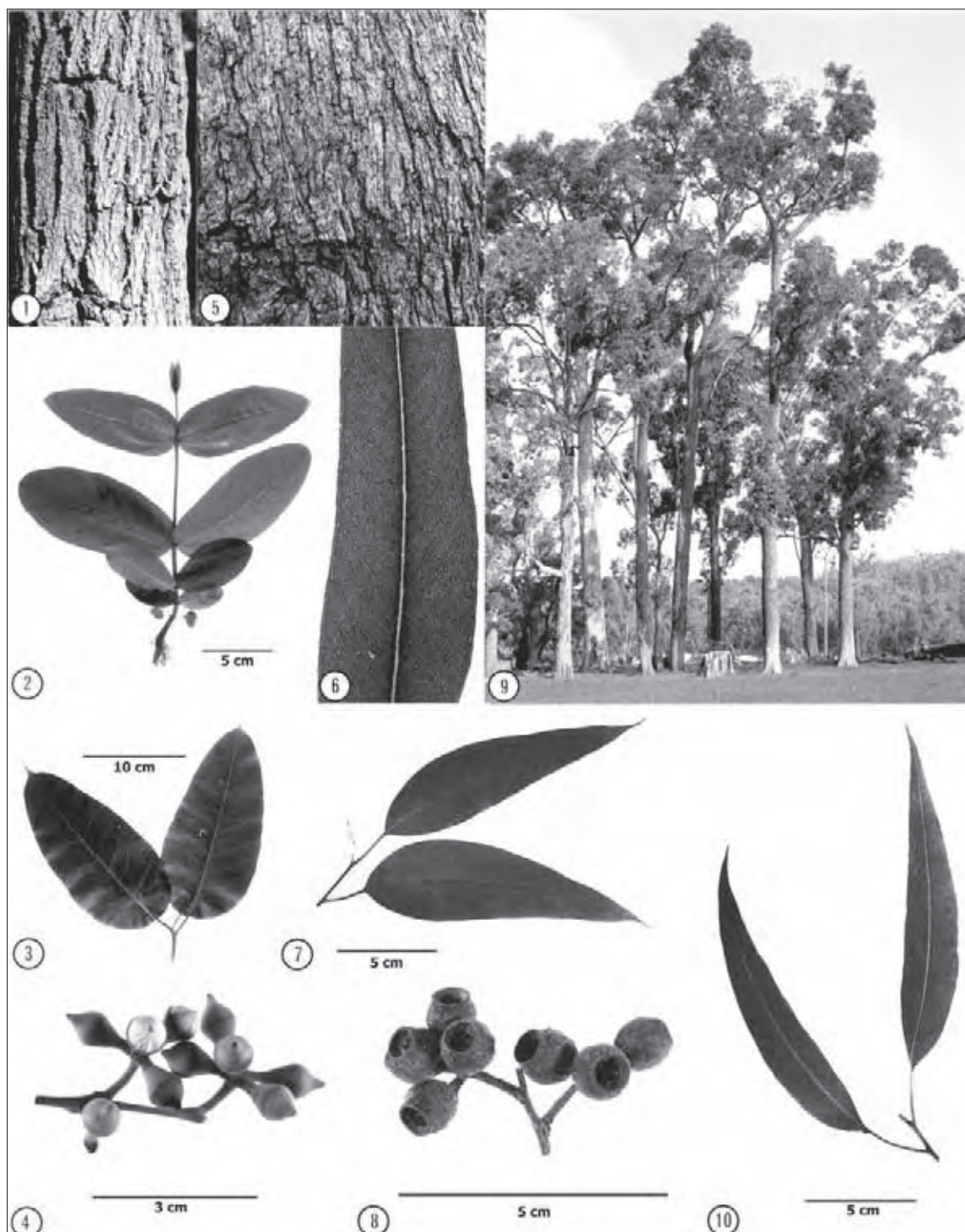
long; buds 0.8–1 × 0.5–0.6 cm; hypanthia slightly campanulate; opercula beaked or conical. Flowers Nov.–Feb.

Fruits: Shortly pedicellate, ovoid to globose, 0.9–1.4 × 0.9–1.2 cm; disc descending; valves 3–5 sometimes just below rim level, other times obscure and deeply enclosed. Seeds D-shaped, shiny brown, hilum terminal.

Wood: Heartwood light to dark brown, hard, tough and moderately durable, intermediate to coarse-textured, interlocked to straight grain, slow to dry with a tendency to check, but does not collapse appreciably; density 690–915 kg m⁻³; used for construction work, railway sleepers, flooring, panelling and cases, but in relatively short supply.

Climate: Altitudinal range: near sea level to 300 m; Hottest/coldest months: 25–31°C/5–9°C; Frost incidence: low to moderate (up to 12 each year at inland sites); Rainfall: 850–1250 mm per year, winter max.

Distinctive features: Bark short-pored, corky, persistent to small branches, conspicuously furrowed longitudinally; adult leaves dull green or bluish green, concolorous, falcate, tapering to a P-ne point; juvenile leaves large, with prominent Ödrip-tipsÖ; usually found growing in depressions.



Eucalyptus patens 1, 5. Bark 2. Seedling 3. Juvenile leaves 4. Buds 6. Adult leaf venation 7. Intermediate leaves 8. Fruits 9. Stand, east of Manjimup, W.A. 10. Adult leaves

Jarrah

Eucalyptus marginata Donn ex Smith

Under optimum conditions jarrah is a tall tree attaining 30–40 m in height with dbh up to 2 m. The bole length rarely exceeds half the total tree height. On poor, deep sands height is reduced and it occurs as a mallee near Mt Lesueur.

Jarrah is widespread in south-west Western Australia. It extends south from the Mt Lesueur area to east of Albany. Eastern outliers occur at Tutanning Reserve south-east of Pingelly and Jilakin Rock east of Kulin. Trees with bluish leaves in the northern Darling Range to near New Norcia represent subsp. *thalassica*. A minor variant (subsp. *elegantella*), which differs by the smaller, narrower leaves, is restricted to the foot of the Darling Range between Perth and Serpentine.

Jarrah is abundant on gravelly and sandy soils on the undulating slopes of the laterite capped Darling Ranges. The gravelly sands may overlap a ferruginous duricrust and typically have deep lower horizons of highly weathered clays. It has its best development and greatest size on red loams of deeply dissected river valleys between the Murray and Warren Rivers. The subsoil comprises an exceptionally deep clay stratum. It is abundant on the Donnybrook Sunkland, a low plateau south of Busselton. Occurrences on the Swan Coastal Plain are on deep sands, while some occurrences in the south of its range include granitic sandy loams.

A feature of jarrah is its occurrence in pure or almost pure stands. On the drier, eastern side of the occurrence where jarrah becomes progressively smaller, there is limited association with wandoo (*E. wandoo*), powderbark wandoo (*E. accedens*) and York gum (*E. loxophleba*).

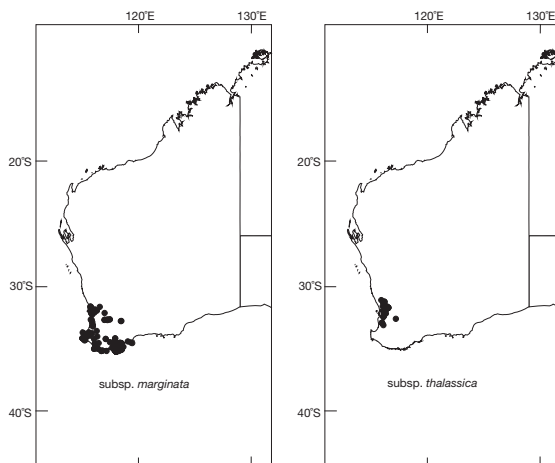
Related species: Brooker (2000) placed jarrah in section *Longistylus*, subsection *Arboreae*, series *Occidentales* with its sister species, Albany blackbutt (*E. staeri*). Albany blackbutt differs by its smaller stature, corky rough bark, thicker, glandless concolorous adult leaves, and larger buds and fruits. The cotyledons of jarrah are unusual in the genus, in their large size and petioles that arise from beneath ground level.

Publication: Subsp. *marginata*: *Trans. Linn. Soc. London* 6, 302 (1802). Type: Cultivated specimen at Kew, United Kingdom, from seed collected by A. Menzies in 1794. Subsp. *thalassica*: *Nuytsia* 9, 5 (1993). Type: Baker's Hill, 27 Aug. 1979, M.I.H. Brooker 6496 & E. Bettenay. Subsp. *elegantella*: *Nuytsia* 9, 4 (1993). Type: Darling Scarp ca 3 km due west of Jarrahdale, Atkinson's property, 30 Mar. 1991, S.D. Hopper 7916.

Names: Botanical Latin *marginatus* (edged, bordered), an obscure allusion to the margins of leaves; Latin *elegans* (elegant) refers to the fine leaves; Greek *thalassicos* (sea-coloured) refers to the colour of the leaves. Common and Aboriginal origin.

Bark: Rough and persistent to the small branches, longitudinally fissured, held in battish strips, brown to red-brown when fresh, weathering to greyish.

Leaves: Seedling opposite and sessile for 3–6 pairs, then becoming alternate and petiolate, ovate, 7–13 × 3.5–6 cm, dark



green, discolorous. Juvenile alternate, petiolate, ovate, 9–13 × 4–6 cm, dark green, discolorous. Intermediate alternate, petiolate, broad-lanceolate, often falcate, 12–17 × 3–4 cm, tapering to a fine point, dark green, discolorous. Adult alternate, petiolate, broad-lanceolate to lanceolate or falcate, 8–13 × 1.5–3 cm, tapering to a fine point, dark green and glossy (*marginata, elegantella*), bluish-grey and dull (*thalassica*), discolorous.

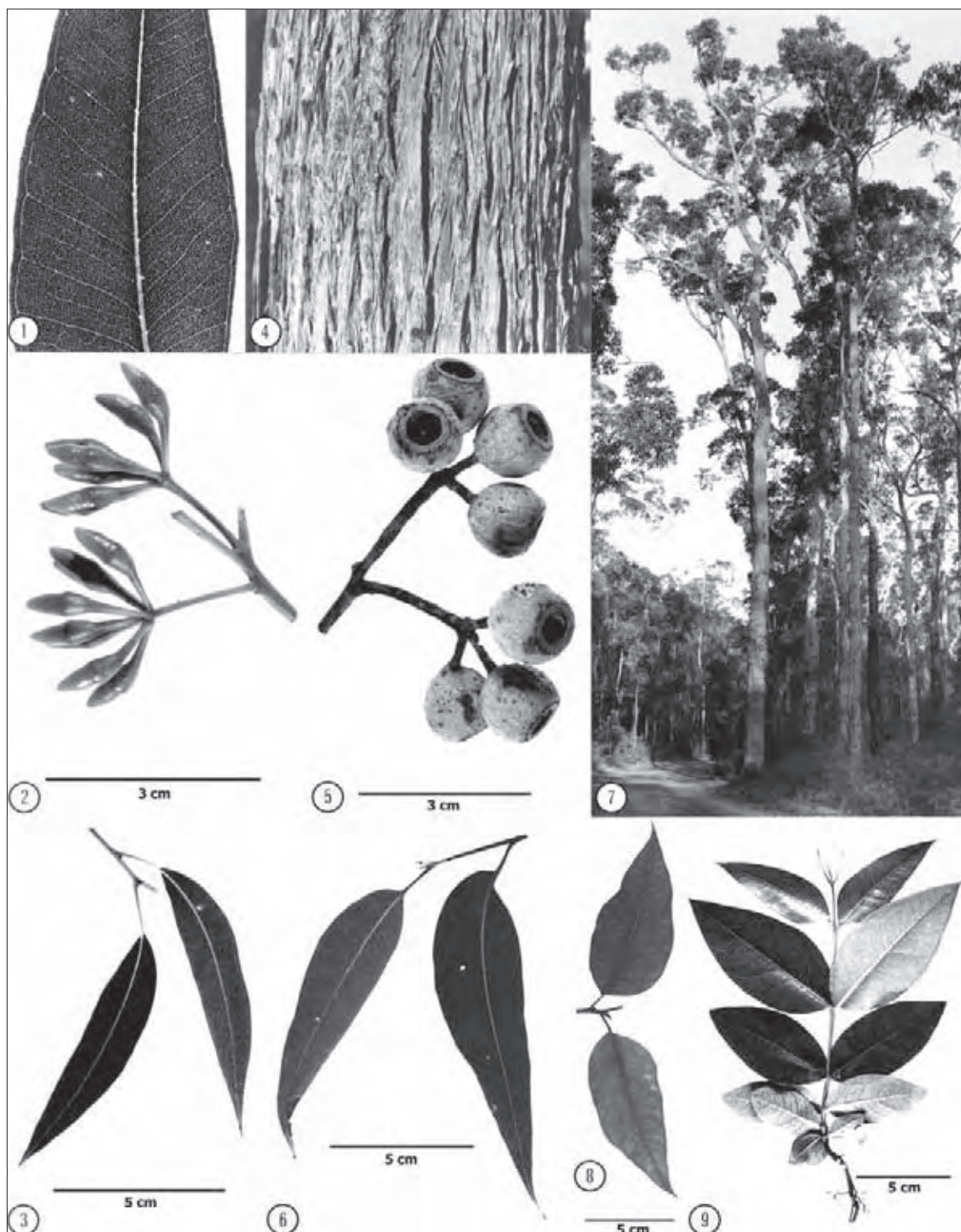
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles slender, terete to slightly angled, 1–2 cm long; pedicels 0.5–1.3 cm long; buds 0.8–1.7 × 0.3–0.5 cm; hypanthia obconical; opercula narrowly conical or horn-shaped, 2–3 times as long as the hypanthia. Flowers Sept.–Dec.

Fruits: Distinctly pedicellate, globose to ovoid, 0.9–1.6 × 0.9–1.5 cm, thick and woody; disc mostly descending at an angle of around 45°, but occasionally vertically depressed or at other times level; valves 3, to rim level or slightly enclosed. Seeds pyramidal, black, hilum terminal.

Wood: Jarrah is one of the most important hardwoods of Australia. Sapwood pale and susceptible to *Lyctus*, heartwood dark red to reddish brown, hard, coarse-textured, strong, durable and termite resistant, with relatively poor burning qualities, but produces excellent charcoal; density 690–995 kg m⁻³, used for heavy construction, either in the round or sawn, piling, railway sleepers, ship building and bridge and wharf construction, as well as for all purposes in house construction, including beams and rafters and is excellent flooring both for appearance and wear. The wood finishes well and is used for the manufacture of high quality furniture. Wood very similar in appearance to karri (*E. diversicolor*) and red mahogany (*E. resinifera*).

Climate: Altitudinal range: 20–300 m; Hottest/coldest months: 25–31°C/5–9°C; Frost incidence: low to moderate (up to 12 each year at inland sites); Rainfall: (500) 600–1250 mm per year, winter max.

Distinctive features: Bark fibrous, held in bat straps, persistent to the small branches; leaves discolorous at all stages; opercula narrowly conical to horn shaped; fruits globose to ovoid, relatively large, woody.



Eucalyptus marginata subsp. *marginata* 1. Adult leaf venation 2. Buds 3. Adult leaves 4. Bark 5. Fruits 6. Intermediate leaves 7. Stand, near Manjimup, W.A. 8. Juvenile leaves 9. Seedling

Red Tingle Red Tingle Tingle

Eucalyptus jacksonii Maiden

Red tingle is one of the largest trees in Western Australia; although it is exceeded in height by karri (*E. diversicolor*), it holds the record for girth with a measurement of 20 m around the buttressed base. Very large specimens may be up to 70 m in height and attain dbh of 4.5 m, but more commonly it occurs up to 55 m in height with dbh up to 2 m. The crown is dense and compact and forms a heavy canopy due to the substantial girth of the branches.

This species has a very restricted natural occurrence, being limited to an area along the lower reaches of the Deep, Frankland and Bow Rivers on the south coast of Western Australia about 100 km west of Albany. Most red tingle populations occur in National Parks and are popular tourist attractions.

Red tingle prefers moderately rich, well-drained loams or sandy loams, mainly derived from granite.

This species grows in tall open eucalypt forests in association with yellow tingle (*E. guilfoylei*), RateŌs tingle (*E. brevistylis*) and karri (*E. diversicolor*).

Related species: Brooker (2000) placed red tingle in section *Longistylus*, subsection *Arboreae* and the monotypic series *Jacksoniae* as it is not closely related to any other species. Because of its rough, stringy bark, it resembles both yellow tingle (*E. guilfoylei*) and RateŌs tingle (*E. brevistylis*) in the feld. Yellow tingle differs in the yellow wood, non-buttressed trunk, predominantly terminal inflorescences, larger, angular buds, and larger and more robust fruits. RateŌs tingle differs in the hemispherical opercula, staminodes and short style, more rugose fruits, prominently petiolate, cordate seedling leaves and yellow wood.

Publication: *J. Proc. Roy. Soc. N.S.W.* 47, 219 (1913). Type: Deep River, Western Australia, Dec. 1912, S.W. Jackson.

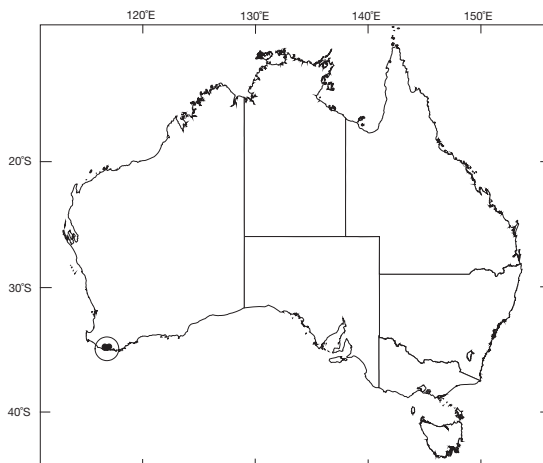
Names: BotanicalŌafter S.W. Jackson (1873Ō1946), the collector of the type specimen. CommonŌrefers to the wood colour, and ŌtingleŌ is of Aboriginal origin.

Bark: Rough and persistent to the small branches, long Ōbred, thick, longitudinally Ōssured, red-brown, weathering to grey-brown.

Leaves: SeedlingŌpposite for several pairs then alternate, sessile, small and elliptical then larger and ovate, 6Ō14 \times 3.5Ō7.5 cm, green, discolorous, with prominent venation. JuvenileŌalternate, petiolate, broadly ovate 12Ō17 \times 6Ō10 cm (sequence similar to in the ash group of eucalypts), green, discolorous. IntermediateŌalternate, petiolate, ovate to broad-lanceolate, 10Ō12 \times 2.5Ō3.6 cm, green, discolorous. AdultŌalternate, petiolate, lanceolate or falcate, slightly oblique, 7.5Ō11 \times 1.4Ō2.5 cm, bright glossy green, discolorous.

Inflorescences: Simple, axillary, 7-flowered; peduncles slightly angular, 0.7Ō1.1 cm long; buds shortly pedicellate, ovoid to clavate, 0.6Ō0.7 \times 0.3Ō0.4 cm; opercula conical, longer than hypanthia. Flowers Jan.ŌMar.

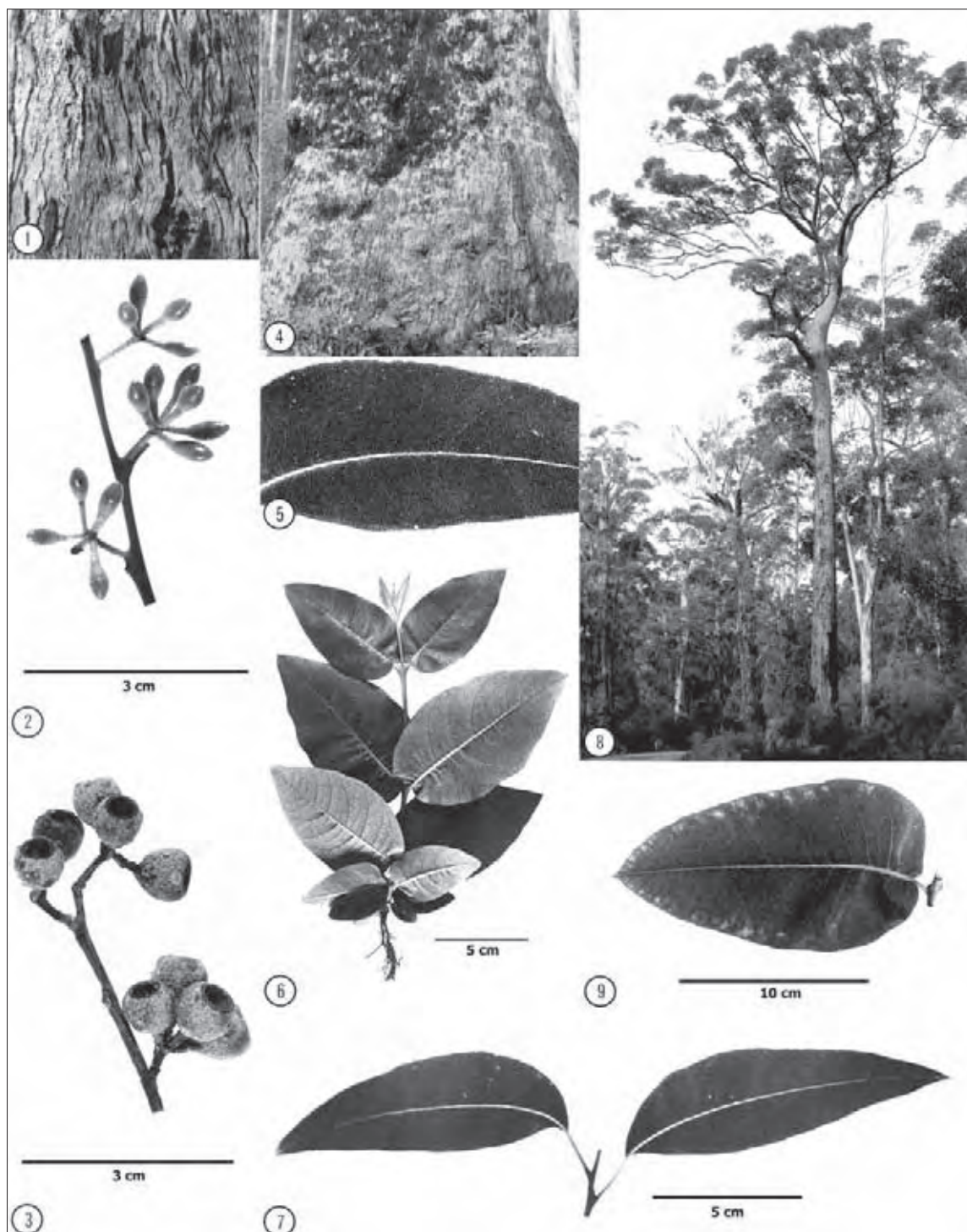
Fruits: Shortly pedicellate, globose, 0.6Ō0.8 \times 0.8Ō1 cm, smooth; disc descending; valves (3)4, small and just enclosed. Seeds pyramidal, lustrous brown, hilum terminal.



Wood: Sapwood not *Lyctus* susceptible, heartwood deep pink to reddish brown, strong, tough, not durable in the ground, works easily, moderately coarse-textured, mostly straight-grained; density 590Ō850 kg m⁻³; once used for home construction, railway sleepers, furniture, but now of limited availability.

Climate: Altitudinal range: 50Ō150 m; Hottest/coldest months: 26Ō27ŌC/6Ō7ŌC; Frost incidence: low; Rainfall: 1150Ō1250 mm per year, winter max.

Distinctive features: Thick, stringy bark persistent to small branches; ash-like seedlings; all leaves discolorous; opercula conical; smooth-walled fruits compared with the wrinkled fruits of *E. brevistylis*; reddish wood.



Eucalyptus jacksonii 1, 4. Bark 2. Buds 3. Fruits 5. Adult leaf venation 6. Seedling 7. Adult leaves 8. Tree, between Manjimup and Walpole, W.A. 9. Juvenile leaf

Rate's Tingle

Eucalyptus brevistylis Brooker

Rate's tingle is a medium-sized to tall tree, attaining heights of 40 m and dbh of 115 m. The trunk is straight and at half to three-quarters of total height the stem branches to form the framework of a moderate-sized but fairly dense crown. Branches typically attain substantial girth.

Rate's tingle has a very restricted natural occurrence east and north-east of Walpole, which is about 105 km west of Albany in south-western Western Australia. To the north of Walpole it extends to Boronia Road. All known stands of Rate's tingle are represented in National Parks.

The habitat consists of nearly level areas near streams and the soil a moderately deep, dark brown loam derived from granite.

Rate's tingle grows in tall open forests in association with karri (*E. diversicolor*), yellow tingle (*E. guilfoylei*), red tingle (*E. jacksonii*), jarrah (*E. marginata*), marri (*E. calophylla*) and bullich (*E. megacarpa*). Ground cover comprises representatives of several shrub genera as well as grass trees (*Xanthorrhoea* species).

Related species: Rate's tingle is not closely related to any other species. Brooker (2000) placed this species in its own section (*Pedaria*), based on its petiolate seedling leaves which are unique in subgenus *Eucalyptus*. In the forest it resembles red tingle (*E. jacksonii*) but differs in the short opercula, short style, staminodes, rugose fruits, different flowering time and petiolate, cordate seedling leaves. The seedling stems may be pruinose. Its yellow wood is also distinctive and resembles the unrelated yellow tingle (*E. guilfoylei*, q.v.).

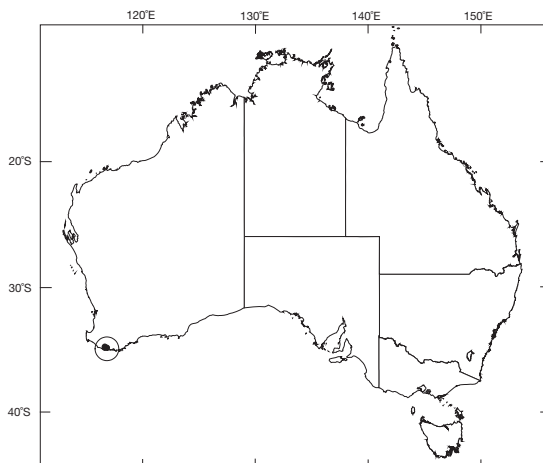
Publication: *Nuytsia* 1, 310 (1974). Type: 22 km NE of Walpole, Western Australia, 15 Feb. 1971, B.R. Maslin 1694.

Names: Botanical Latin *brevis* (short), *stylis* (style), in reference to the conspicuously short style. Common names: forester J. Rate, whose collections and persistent efforts resulted in the trees being recognised as a distinct species; 'tingle' is of Aboriginal origin.

Bark: Rough and persistent to the small branches, brous, thick, somewhat finely fissured longitudinally and having a distinctive corrugated appearance at the root swell, yellowish brown.

Leaves: Seedling: opposite for a few pairs then alternate, petiolate, ovate, cordate, 3.6 × 2.4 cm, green, discolorous; stems may be pruinose. Juvenile: alternate, petiolate, ovate, early pairs cordate, 6.8 × 4.5–5.5 cm, green, discolorous; stems usually pruinose. Intermediate: alternate, petiolate, ovate to broad-lanceolate, falcate and oblique, 8.11 × 3.4 cm, green, discolorous. Adult: alternate, petiolate, broad-lanceolate or falcate and oblique, 7.9 × 2.3 cm, often with a small hooked tip, glossy green, discolorous.

Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles terete to slightly angular, 0.7–1.4 cm long; pedicels 0.3–0.6 cm long; buds ovoid to clavate, 0.3–0.4 × 0.2–0.3 cm; opercula hemispherical. Flowers Apr.–May.

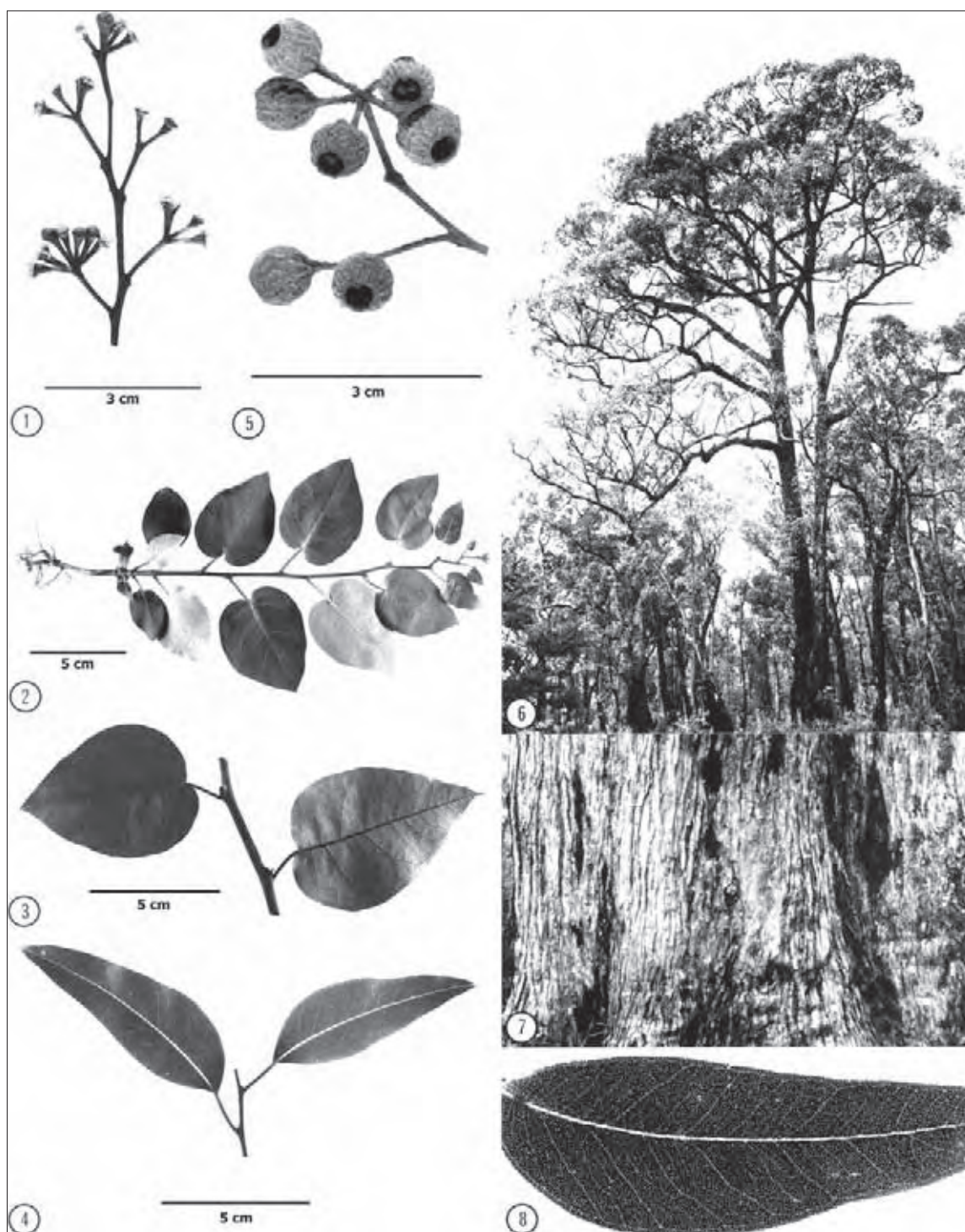


Fruits: Pedicellate, truncate-ovoid to globose, wrinkled (especially when dry), sometimes shallowly ribbed, 0.6–0.9 × 0.6–0.9 cm; disc descending, oblique to vertical; valves 3, obscure, deeply enclosed. Seeds pyramidal, brown, hilum terminal.

Wood: The physical properties are reported to be similar to those of yellow tingle (*E. guilfoylei*) (q.v.).

Climate: Altitudinal range: 30–300 m; Hottest/coldest months: 24°C/7°C; Frost incidence: low; Rainfall: 1000–1150 mm per year, winter max.

Distinctive features: A large tree with the general appearance of red tingle (*E. jacksonii*); small, strongly discolorous adult leaves; pedicels longer than the buds, which are small, ovoid to clavate, with short, hemispherical opercula; fruits truncate-ovoid, rugose, with a depressed disc and deeply enclosed valves; seedling stems somewhat pruinose with petiolate, ovate, cordate leaves.



Eucalyptus brevistylis 1. Buds and flowers 2. Seedling 3. Juvenile leaves 4. Adult leaves 5. Fruits 6. Tree, near Walpole, W.A. 7. Bark 8. Adult leaf venation

Broad-leaved White Mahogany

Eucalyptus umbra R.T. Baker and *E. carnea* R.T. Baker

These species may vary from a bushy shrub, sometimes less than 1 m high on exposed shorelines, to a small or medium-sized tree 8–25 m in height and 1 m or more dbh when growing under favourable conditions.

Broad-leaved white mahogany was previously recognised to comprise two subspecies but are now considered distinct species. *E. umbra* extends north from the Sydney area along the coast of New South Wales into south-eastern Queensland where it occurs from east of Gympie to north of Bundaberg. *E. carnea* tends to have a more inland occurrence and extends from the Hunter River in New South Wales north to Gympie in Queensland.

These species occur on a wide range of topography including coastal flats, steep, well-drained slopes and sandstone escarpments. The soils are commonly poor, though the species may occur on moderately good loams in valleys. In New South Wales, *E. umbra* favours poor siliceous soils not far from the sea while *E. carnea* prefers stony but less siliceous hillsides more distant from the sea.

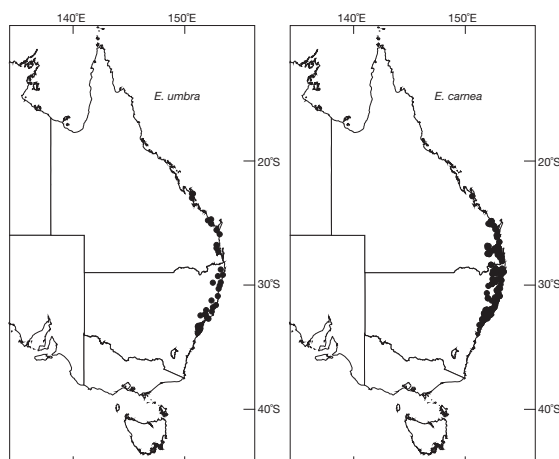
Broad-leaved white mahoganies occur mainly in open forests associated with a wide range of species including grey gum (*E. propinqua*), grey ironbark (*E. paniculata*), grey box (*E. moluccana*) and red bloodwood (*E. gummifera*) in the southern parts of the distribution, while in Queensland the associated species include pink bloodwood (*E. intermedia*), forest red gum (*E. tereticornis*), white gum (*E. platyphylla*) and carbeen (*E. tessellaris*).

Related species: Brooker (2000) placed these two species in section *Amentum*, a group of species endemic to Queensland and New South Wales. The section is regarded as primitive in subgenus *Eucalyptus* with the opposite juvenile leaves and the dense reticulation of the adult leaves. The group is notably rough-barked, the bark being held in battish strips. The morphological differences between species in section *Amentum* are subtle. *E. acmenoides*, has strongly discoloured, relatively thin adult leaves and thin-walled fruit compared to *E. umbra*, which has coarser, concolorous leaves and thick-walled fruit. Johnson and Hill (1990) and Hill (1999) segregated taxa from the two species treated here (e.g. *E. latisinensis*; *E. psammitica*), which are difficult to identify.

Publication: *E. umbra*: J. & Proc. Linn. Soc. N.S.W. 25, 687 (1901). Type: Gosford, New South Wales, 14 Nov. 1893, J. Martin (fide Hill 1999). *E. carnea*: Proc. Linn. Soc. N.S.W. 31, 303 (1906). Type: Wardell, Lismore, New South Wales, 14 Nov. 1893, W. Baeuerlen (fide Hill 1999).

Names: Botanical Latin *umbra* (shade); Latin *carneus* (flesh-coloured), presumably of the heartwood. Common refers to the broadish leaves, to the bark and to the wood (mahogany originally referred to the red-coloured wood of the red mahoganies, *E. resinifera* etc., because of its supposed resemblance to the wood of the central American *Swietenia mahoganii* and used for other rough-barked trees).

Bark: Fibrous, but not as coarse as a typical stringybark, moderately to deeply longitudinally fissured, thick, grey to brownish-grey, persistent to the small branches, often held as battish strips somewhat like that in jarrah.



Leaves: Seedling Opposite, sessile and amplexicaul, for 6–12 pairs then becoming alternate, petiolate, ovate, 6–13 × 3–7.5 cm, dark green, glossy, strongly discoloured. Juvenile Alternate, petiolate, ovate, 10–20 × 5.5–10 cm, dark green, glossy, discoloured at first, later leaves becoming almost concolorous; to this stage leaves are held more or less horizontally. Intermediate Alternate, petiolate, broad-lanceolate, 13–18.5 × 3–4.5 cm, green in *umbra*, bluish green in *carnea*, almost concolorous. Adult Alternate, petiolate, lanceolate, tending to falcate and oblique, 10–14 × 2–2.5 cm, almost concolorous; canopy green in *umbra*, bluish green in *carnea*.

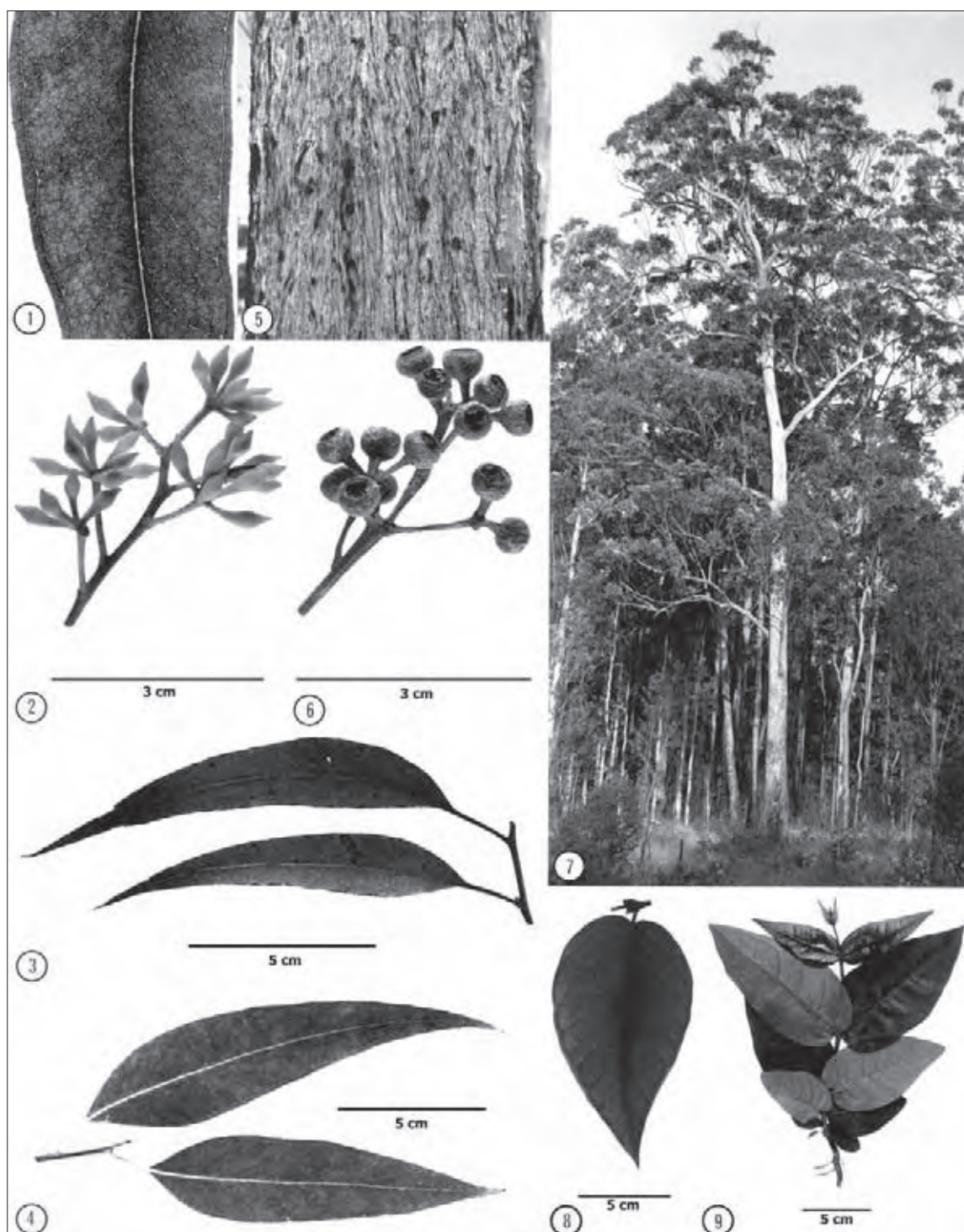
Inflorescences: Simple, axillary or apparently terminal, 7 to 11-flowered; peduncles slightly angular to distinctly flattened, 0.6–2.1 cm long; pedicels relatively stout, angular, 0.2–0.7 cm long; buds ovoid to fusiform, 0.7–0.9 × 0.3–0.4 cm; opercula conical or rostrate. Flowers spring to early summer.

Fruits: Pedicellate, hemispherical to truncate-globose, 0.4–0.6 × 0.5–0.8 cm; disc generally prominent, level or slightly ascending, but sometimes narrow and obscure; valves 3–5, generally about rim level, sometimes with thin tips protruding. Seeds pyramidal or obliquely pyramidal, red-brown, hilum terminal.

Wood: Heartwood light brown in *umbra*, pinkish brown in *carnea*, close-textured, moderately heavy, moderately durable; density 925 kg m⁻³; wood is identical to that of white mahogany (*E. acmenoides*) (q.v.) and is used for similar purposes.

Climate: Altitudinal range: near sea level to 1000 m (*umbra*), near sea level to 600 m (*carnea*); Hottest/coldest months: 26–34°C/4–10°C (*umbra*), 26–31°C/4–8°C (*carnea*); Frost incidence: low to moderate (*umbra*, *carnea*), with up to 15 each year at high elevations; Rainfall: 700–1400 mm per year (*umbra*), 750–1650 mm per year (*carnea*), summer max. (*umbra*, *carnea*).

Distinctive features: A small to medium-sized tree, with fibrous bark to small branches often held in battish strips; seedling leaves opposite, sessile, ovate, glossy, strongly discoloured; adult leaves more or less leathery, slightly discoloured or concolorous; inflorescences sometimes terminal; fruits hemispherical.



Eucalyptus umbra (u), *E. carnea* (c) 1. Adult leaf venation (c) 2. Buds (c) 3. Adult leaves (c) 4. Intermediate leaves (c) 5. Bark (u) 6. Fruits (u) 7. Tree, Tabbimoble State Forest, south-west of Woodburn, N.S.W. (u) 8. Juvenile leaf (c) 9. Seedling (c)

White Mahogany Yellow Stringybark (Qld)

Eucalyptus acmenoides Schauer

White mahogany can be a very tall tree to 60 m in height and over 1 m dbh and occasionally develops a massive butt. On drier sites the dimensions are smaller and the height may not exceed 25 m. The trunk is generally at least half the total height of the tree, while the crown is somewhat open.

This species is common in coastal areas from near Sydney in New South Wales northwards to Proserpine in Queensland. White mahogany populations from coastal and subcoastal sites in north Queensland has been recognised as a new species, *E. portuensis* (see below).

This species grows on a wide range of topography. In New South Wales it commonly occurs on ridges and hills below 300 m altitude. The Queensland occurrence extends to the plateaux and hills of the Great Dividing Range. It is commonly found on the drier ridges in coastal areas, where the intermediate slopes may support nearly pure blackbutt (*E. pilularis*) stands. It grows on loams and clays, derived from volcanic, sedimentary or metamorphic substrates.

White mahogany is mainly a species of open and tall open forests. On the ridges, associated eucalypts include grey gums (mainly *E. propinqua*), grey ironbark (*E. paniculata*), various stringybarks, especially white stringybark (*E. globoidea*) and red bloodwood (*E. gum-mifera*). On the more favourable sites there may be Sydney blue gum (*E. saligna*) and tallowwood (*E. microcorys*). In some areas there may be spotted gums (e.g. *E. maculata*) and forest red gum (*E. tereticornis*). White mahogany often occurs as scattered specimens.

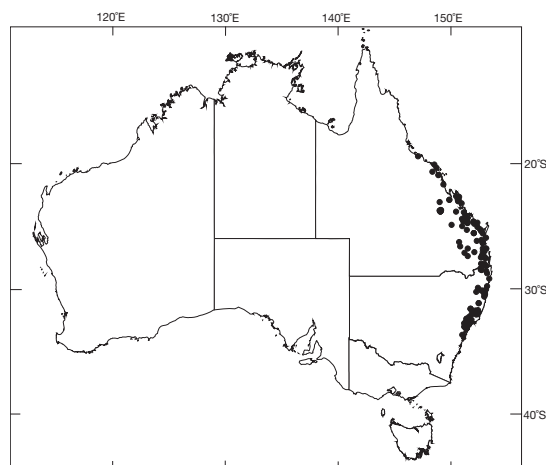
Related species: Brooker (2000) placed white mahogany in section *Amentum*, a small group of species endemic to Queensland and New South Wales. The section is regarded as primitive in subgenus *Eucalyptus* with the opposite juvenile leaves and the dense reticulation of the adult leaves. The morphological differences between species in section *Amentum* are subtle. White mahogany is the most distinctive species in the section and has strongly discolorous, relatively thin adult leaves and thin-walled fruit compared to the other well-known white mahogany, *E. umbra*, which has coarser, concolorous leaves and generally thick-walled fruit. Subgeneric hybrids between white mahogany and Gympie messmate (*E. cloeziana*) have been verified (see Gympie messmate for discussion).

Publication: In *Walper's Repert. Bot. Syst.* 2, 924 (1843). Type: *ÖIn sylvis Novae Cambriae australis* (in forests of New South Wales), 14 Jan. 1817, A. Cunningham.

Names: Botanical from *Acmena*, a genus of which some species have apparently similar leaves. Common a loose term covering a number of rough-barked trees (see under *E. umbra*).

Bark: Rough and persistent over the whole of the trunk and branches, fibrous and tending to be held in battish strips, with shallow longitudinal fissures, firm, grey-brown.

Leaves: Seedling opposite, sessile and amplexicaul, for 9–12 pairs, lanceolate, 7–13 × 2.5–5 cm, dark green, glossy, strongly



discolorous. Juvenile opposite and sessile at first, soon alternate and shortly petiolate, ovate, 10–12 × 4.5–5.5 cm, glossy green, discolorous, tapering to a long, fine point. Intermediate alternate, petiolate, broad-lanceolate, 12–17.5 × 3–4.5 cm, green, discolorous, tapering to a long, fine point. Adult alternate, petiolate, broad-lanceolate to lanceolate, 8–12.5 × 1.6–2.7 cm, thin, slightly glossy, green, discolorous, tapering to a long, fine point.

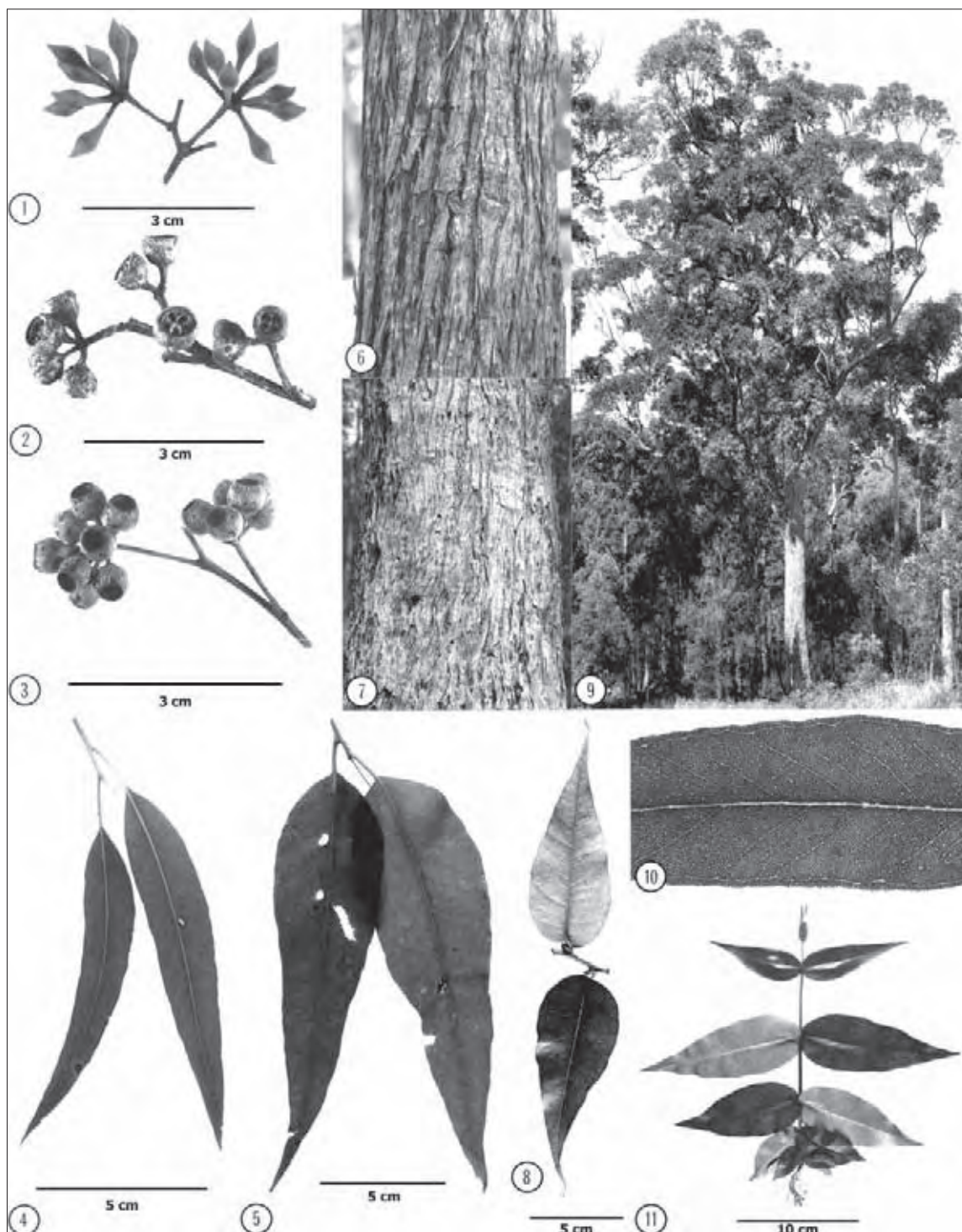
Inflorescences: Simple, axillary or apparently terminal, 9 to 15-flowered; peduncles angular to flattened, 0.6–1.2 cm long; pedicels 0.2–0.6 cm long; buds ovoid to fusiform, 0.5–0.7 × 0.3–0.4 cm; opercula conical to rostrate. Flowers Oct.–Feb.

Fruits: Pedicellate, hemispherical to truncate-globose, 0.4–0.7 × 0.4–0.7 cm; disc variable, usually narrow, obscure, sometimes broader, level to descending; valves (3)4, to rim level or enclosed. Seeds pyramidal or obliquely pyramidal, red-brown, hilum terminal.

Wood: Sapwood seldom attacked by *Lyctus* borers; heartwood light yellowish brown to light brown to brown, similar to that of yellow stringybark (*E. muelleriana*) and tallowwood (*E. microcorys*) but with kino (gum) veins, fine-textured, grain usually interlocked, hard, strong, stiff and tough, very durable and termite resistant; density 795–1010 kg m⁻³; used for poles, railway sleepers, bridge and wharf construction as well as stumps, plates, flooring, joists and weatherboards. Tallowwood is usually coarser-textured and more greasy to the feel than white mahogany; yellow stringybark is not greasy.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest months: 26–32°C/2–13°C; Frost incidence: low to moderate (20 or more each year at high elevations); Rainfall: 700–1700 mm per year, summer max.

Distinctive features: Medium-sized to very tall tree; bark fibrous, persistent to the small branches, often held in battish strips; adult leaves thin, discolorous; buds distinctly pedicellate; opercula somewhat longer than wide, usually beaked; small hemispherical fruits generally with thin rims.



Eucalyptus acmenoides 1. Buds 2, 3. Fruits 4. Adult leaves 5. Intermediate leaves 6. Bark of young tree 7. Bark of mature tree 8. Juvenile leaves 9. Tree, Candole State Forest, east of Grafton, N.S.W. 10. Adult leaf venation 11. Seedling

Blackbutt

Eucalyptus pilularis Smith

Blackbutt is a tall to very tall tree occasionally attaining 70 m in height and exceeding 3 m dbh. The trunk is straight and half to two-thirds of the tree height. The crown tends to be densely foliated.

This is an abundant species in many places in coastal New South Wales from south of Bega, near the Victorian border, northwards into south-eastern Queensland north to Fraser Island and north of Toowoomba.

This species is typically found on gentle slopes of hilly country between the sea and the coastal escarpment of the Great Dividing Range. It mainly occurs on sandy loams or loams, and grows satisfactorily on clays and volcanic soils.

Blackbutt usually occurs in tall open forests of high quality, sometimes on drier slopes adjacent to rainforest. Associated eucalypts include a wide range of species such as tallowwood (*E. microcorys*), Sydney blue gum (*E. saligna*) and also turpentine (*Syncarpia glomulifera*). In drier areas it may occur with spotted gums (*E. maculata*, *E. citriodora* subsp. *variegata*) and smooth-barked apple (*Angophora costata*). It also occurs in large, almost pure stands.

Related species: Blackbutt belongs to a small group of just two species (section *Pseudophloius*) which are distinctive in the erect tree habit, part or wholly rough bark, the many pairs of large, glabrous juvenile leaves, the relatively large, glossy green adult leaves, the coarse flattened peduncles, and the relatively large, pedicellate buds and fruits (Brooker 2000). Blackbutt is closely related to large-fruited blackbutt (*E. pyrocarpa*), which occurs within the distribution of blackbutt but displaces it at higher elevations, and which differs by the pruinose branchlets, and larger buds and fruits.

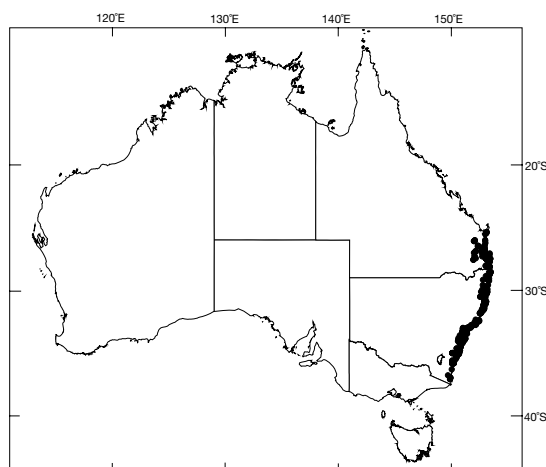
Publication: *Trans. Linn. Soc. London* 3, 284 (1797). Type: Port Jackson, New South Wales, 1794, J. White.

Names: Botanical Latin, from *pilula* (small pill or rounded knob), alluding to the fruit shape. Common refers to the lower trunk (really only applicable after Pre has darkened the basal rough bark).

Bark: Rough and persistent on the major part of the trunk, grey-brown, finely brous and becoming ragged in old trees towards the base, shedding in strips from the upper trunk leaving a smooth white or yellowish grey surface. Insect scribbles are often conspicuous on the upper smooth bark.

Leaves: Seedling opposite for many pairs, sessile, amplexicaul, more or less elliptical, 5.5–13 × 1.1–4 cm strongly discolorous. Juvenile opposite, sessile, amplexicaul, broad-lanceolate to lanceolate, 13–17 × 2.5–3.5 cm; colour as for seedling stage. Stems markedly 4-sided with flanged edges. Adult alternate, petiolate, lanceolate, 7.5–17 × 1.2–3.2 cm, glossy green, concolorous.

Inflorescences: Simple, axillary, 7 to 15-flowered; peduncles flattened, 1–1.7 cm long; pedicels angular, 0.3–0.6 cm long; buds clavate or broadly fusiform, 0.8–1.1 × 0.4–0.5 cm; opercula conical to rostrate. Flowers Sept–Mar.

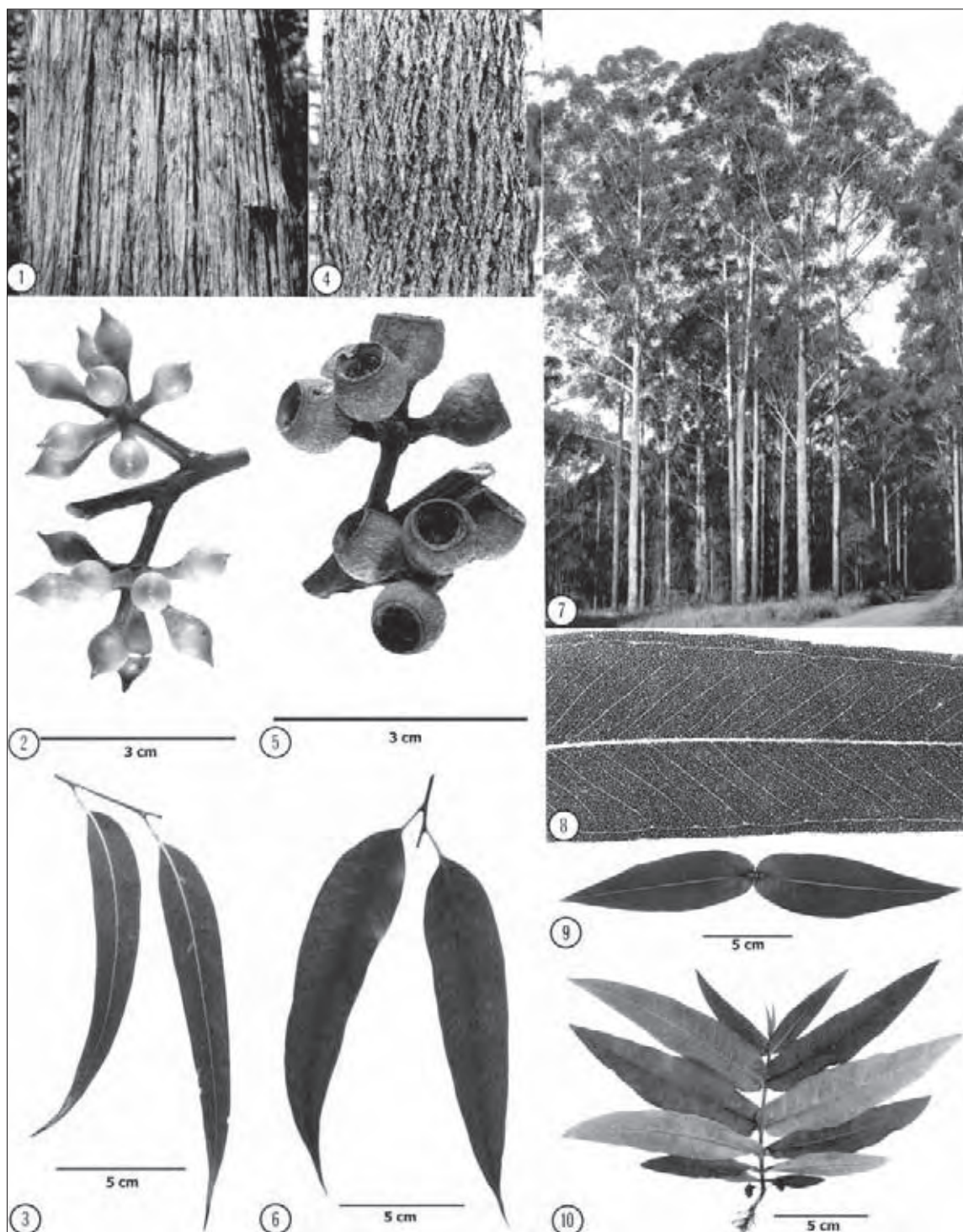


Fruits: Pedicellate, ovoid, hemispherical or truncate-globose, 0.6–1.1 × 0.7–1.1 cm; disc varies from slightly ascending to level or steeply descending; valves usually 4, about rim level or slightly enclosed. Seeds pyramidal or obliquely pyramidal, dark brown to red-brown, hilum terminal.

Wood: Sapwood resistant to attack by *Lyctus* borers; heartwood light brown or yellowish brown, coarse-textured, grain usually straight, small kino (gum) veins common and occasional pinhole borer holes can be observed, hard, strong, tough but not difficult to work, rather slow drying, moderate to good durability; density 720–1005 kg m⁻³, one of the most important hardwoods of Australia, and the principal species sawn in coastal New South Wales and south-eastern Queensland; used for general building construction, flooring, poles, railway sleepers, veneer and plywood and is suitable for pulp. Wood is similar to tallowwood (*E. microcorys*) but lacks greasy feel.

Climate: Altitudinal range: near sea level to 700 m; Hottest/coldest months: 24–32°C/0–10°C; Frost incidence: low to moderate; Rainfall: 900–1750 mm per year, uniform to summer max.

Distinctive features: Without lignotubers; bark brous, persistent from a short stocking to about half of the trunk; seedlings and saplings conspicuous in the field with many pairs of opposite, broad-lanceolate, strongly discolorous leaves; fruits hemispherical or truncate-globose, distinctly pedicellate.



Eucalyptus pilularis 1. Bark, mature tree 2. Buds 3. Adult leaves 4. Bark, young tree 5. Fruits 6. Intermediate leaves 7. Stand, Cooperook State Forest, N.S.W. 8. Adult leaf venation 9. Juvenile leaves 10. Seedling

Large-fruited Blackbutt

Eucalyptus pyrocarpa L.A.S. Johnson & D.F. Blaxell

Large-fruited blackbutt is a medium-sized to tall tree 20–45 m in height and 1–2 m dbh. Tree form is good on all but the poorest sites.

Large-fruited blackbutt occurs in small, scattered communities, often forming mosaics with *E. pilularis*, in the north coast region of New South Wales. The distribution of the species is wholly in New South Wales. It extends discontinuously from the vicinity of Woodburn in the north to near Wauchope in the south. An isolated occurrence has also been reported in the Gibraltar Range near Glen Innes.

This species displaces *E. pilularis* at higher elevations in more exposed sites which are better drained and where the nutrient status of the soil is low. The species grows typically on duplex soils derived from conglomerate or coarse sandstones. Between Coramba and Ulong, west of Coffs Harbour, the species grows on dry, shallow soils of metamorphic origin.

Large-fruited blackbutt occurs in open to tall open eucalypt forests, commonly associated with species such as red bloodwood (*E. gummifera*), needlebark stringybark (*E. planchoniana*), white mahogany (*E. umbra*) and apple (*Angophora costata*).

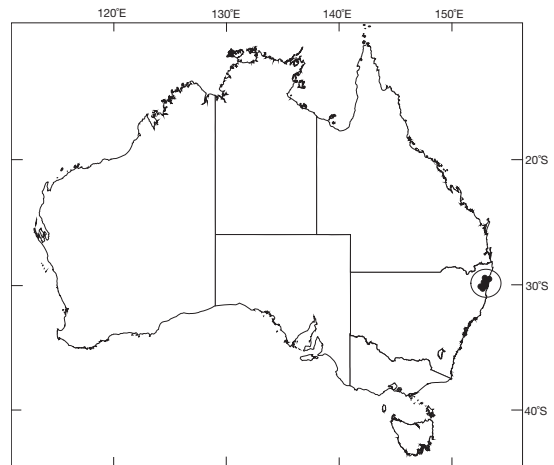
Related species: Large-fruited blackbutt belongs to a small group of just two species (section *Pseudophloius*) which are distinctive in the erect tree habit, trunk part or wholly rough-barked, the many pairs of large, glabrous juvenile leaves, the relatively large, glossy green adult leaves, the coarse flattened peduncles, and the relatively large, pedicellate buds and fruits (Brooker 2000). This blackbutt is closely related to *E. pilularis*, which has a much larger distribution from near Bega in southern New South Wales north to Fraser Island in Queensland and which differs by the non-pruinose branchlets, and smaller buds and fruits.

Publication: *Contr. N.S.W. Natl Herb.* 4, 454 (1973). Type: Bucca Creek near Coffs Harbour, New South Wales, Jun. 1911, J.L. Boorman.

Names: Botanical Latin *pyrus* (pear), Greek *carpos* (fruit), of the shape of the fruit (a misnomer). Common refers to the fruit size compared with *E. pilularis*, and to the bark.

Bark: Rough and persistent on the trunk, ragged, subbrous, brownish, often extending onto the larger branches, then smooth, grey-white or yellowish. The name blackbutt really only describes trees that have been singed by fire, unburnt trees having brown lower bark.

Leaves: Seedling opposite for many pairs, sessile, amplexicaul, a few pairs more or less elliptical, later ones broad-lanceolate, 6–12 × 2.5–3.5 cm, strongly discolorous (greyish green above, greyish white below). Juvenile stems pruinose, opposite, sessile, amplexicaul, broad-lanceolate to lanceolate, 13–21 × 1.3–5 cm; colour as for seedling stage. Stems at the seedling and juvenile stages are markedly 4-sided with flanged edges, and are pruinose at all stages. Intermediate alternate, petiolate, lanceolate, 18–22 × 2.7–3.2 cm, green, concolorous. Adult alternate, petiolate,



lanceolate, 12–20 × 1.6–2.8 cm, green, concolorous. Branchlets pruinose.

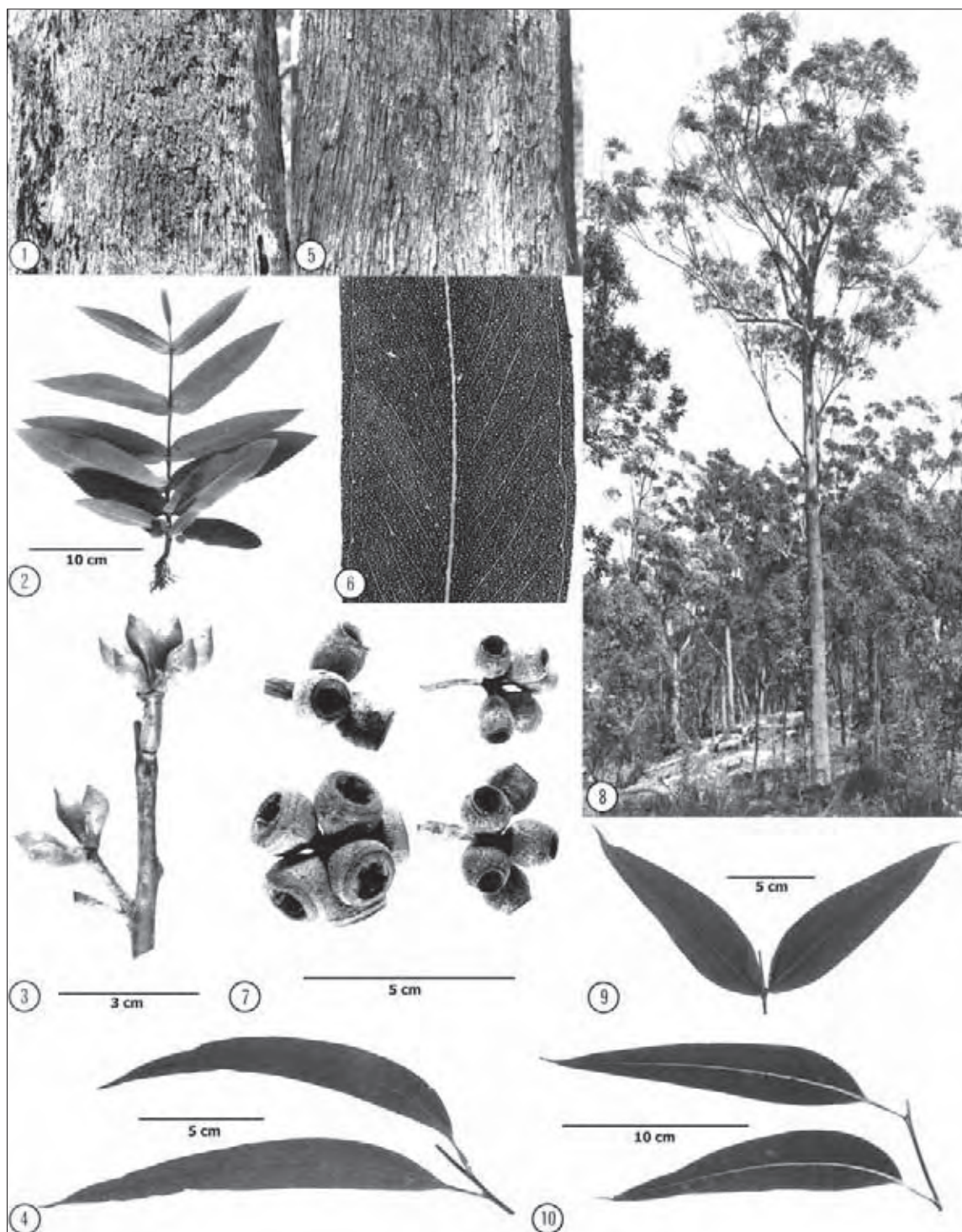
Inflorescences: Simple, axillary, 7 to 11-flowered, peduncles flattened, 1–2.5 cm long, pedicels occasionally absent or up to 0.7 cm long, angular; buds clavate or broadly fusiform, 0.8–1.4 × 0.5–0.6 cm, sometimes faintly ribbed; opercula conical to slightly rostrate; peduncles, pedicels and lower parts of hypanthia pruinose. Flowers Jan.–Mar.

Fruits: Sessile or shortly pedicellate, pedicels pruinose, very variable in shape, truncate-ovoid, truncate-globose or hemispherical, 0.8–1.5 × 0.7–1.7 cm, lower part of hypanthia usually pruinose; disc relatively narrow to broad, descending, more or less level or ascending; valves 4, about rim level or enclosed. Seeds pyramidal or obliquely pyramidal, dark brown to red-brown, hilum terminal.

Wood: The properties and uses of the timber are very similar to those of blackbutt (*E. pilularis*). A poorly formed tree of *E. pyrocarpa* when cut usually has less timber defect than a similar tree of *E. pilularis*.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest months: 27–30°C/(–2)–5–7°C; Frost incidence: low (but moderate to high at highest elevations); Rainfall: 1100–1700 mm per year, summer max.

Distinctive features: A non-lignotuberous tree of higher elevations and poorer fertility sites than *E. pilularis*; rough bark over most of the trunk; seedlings with many pairs of opposite leaves; stems and branchlets at all stages pruinose; relatively large, woody fruits; lower part of hypanthia of buds and fruits generally pruinose.



Eucalyptus pyrocarpa 1, 5. Bark 2. Seedling 3. Buds 4. Adult leaves 6. Adult leaf venation 7. Fruits 8. Tree, Candole State Forest, east of Grafton, N.S.W. 9. Juvenile leaves 10. Intermediate leaves

■ Stringybarks

Eucalyptus section *Capillulus* Brooker

There are about 30 species of stringybarks most of which are distributed in the tablelands, ranges and coastal areas of New South Wales and Victoria. There are six or seven species in similar habitats in Queensland, including the Queensland white stringybarks, viz. *E. tindaliae*, which is continuous with occurrences in northern New South Wales to as far north as Maryborough and *E. reducta*, which occurs from north-west of Townsville to the Atherton Tableland and Daintree and as far north as the Helenvale area. Red stringybark (*E. macrorhyncha*), which is very common on the tablelands of New South Wales and in inland Victoria, has a restricted, disjunct distribution in the hills south-west of Clare in mid-north South Australia.

Several species, e.g. yellow stringybark (*E. muelleriana*), white stringybark (*E. globoidea*) and blue-leaved stringybark (*E. agglomerata*), of the eastern side of the Southern Tablelands and the South Coast of New South Wales occur in well-watered regions in tall open forest with a large variety of associated species. In drier areas of the Northern Tablelands *E. macrorhyncha* dominates and may occur in woodlands often with red gums and boxes or in open forests with broad-leaved peppermint (*E. dives*) and scribbly gum (*E. rossii*).

Some stringybarks are adapted to the poorest soils derived from Hawkesbury sandstone of the coastal ranges of New South Wales. These include the small tree, narrow-leaved stringybark (*E. sparsifolia*) and the dwarf privet-leaved stringybark (*E. ligustrina*). Desert stringybark (*E. arenacea*) from the south-east of South Australia and western Victoria is also adapted to poor, sandy soils and has a low mallee habit. One of the few Queensland stringybarks, swamp stringybark (*E. conglomerata*), is also a mallee or small tree adapted to swampy sites.

Many of the tall stringybark species are of commercial importance attaining heights of 35–50 m. These include *E. muelleriana*, *E. tindaliae*,

E. baxteri and blue-leaved stringybark (*E. agglomerata*). The wood is commonly brown, hard, strong and durable and is used for heavy construction, railway sleepers, poles and fence posts.

Botany

The stringybarks are a distinctive group and can usually be recognised by the bark which is rough and persistent over most or all of the trunk, thick, long fibred, usually furrowed longitudinally and can be pulled off in long strings. This is in contrast to the flakier bark of other coarsely fibrous-barked species occurring in similar habitats such as the white mahoganies (*E. umbra* and *E. acmenoides*), the red mahoganies (*E. pellita* and *E. resinifera*) and tallowwood (*E. microcorys*).

Stringybarks can usually be recognised from the seedlings which bear shortly petiolate, undulate, discolorous leaves which are hispid with stellate hairs, although the amount of pubescence varies and is sparse in *E. muelleriana*.

Although the seedling leaf shape varies considerably between species, e.g. narrow in McKie's stringybark (*E. mckieana*) and broad in Diehard stringybark (*E. cameronii*), adult leaves of most species are lanceolate, or falcate and oblique, and slightly glossy. Only in *E. muelleriana* are they discolorous. Most stringybarks have green adult leaves but in *E. agglomerata* they are slightly bluish green and the canopy looks characteristically bluish in early morning or late afternoon light, particularly when disturbed by a light wind.

Buds vary from sessile or shortly pedicellate in white stringybark (*E. globoidea*) to prominently pedicellate in silvertop stringybark (*E. laevopinea*), smooth in *E. muelleriana*, warty in *E. baxteri* or angular in Youman's stringybark (*E. youmanii*). The pedicel character is somewhat arbitrary as the bud stalk may be prominent when the bud is young, only to be apparently lost when the bud enlarges towards its maturity, i.e. immediately before flowering. The fruits may have conspicuous valves as in *E. baxteri* or inconspicuous, sunken valves as in *E. sparsifolia*.

Undamaged aggregations of fruits are often distinctive, as many of the species produce tight

clusters of sessile to shortly pedicellate fruits which are usually broader than long. In species like *E. agglomerata* the fruits are very tightly clustered and the sides are distorted and flattened due to the sideways pressures of the enlarging fruits. In a few species, e.g. *E. laevopinea*, the fruits are clearly pedicellate. The shrubby *E. verrucata* of mountain tops in the southern Grampians of western Victoria has the largest fruits of the stringybarks and is notable also for its coarse, thick leaves and densely warted buds.

It is difficult to segregate the species into definitive series, but a handy aid to identification is the recognition of four groups based on bud characters;

- (a) distinctly pedicellate, clavate buds (e.g. *E. muelleriana*, *E. laevopinea*);
- (b) fusiform buds, i.e. with pointed opercula (e.g. *E. globoidea*);
- (c) buds with blunt opercula (e.g. *E. baxteri*);
- (d) angular, almost sessile buds (e.g. *E. youmanii*).



Stringybarks range from being low shrubs to tall forest trees. 1. Mongamulla mallee (*E. deuaensis*), Mongamulla Mountain, N.S.W., has a mallee habit and is known from only one site, and 2. Tindal's stringybark (*E. tindaliae*) is a tall tree at Bunya Mountains National Park, Qld. 3. The fruit capsules of blue-leaved stringybark (*E. agglomerata*) are so tightly clustered that they have slightly distorted sides.

Yellow Stringybark

Eucalyptus muelleriana A. Howitt

Yellow stringybark is commonly a tall tree 25–40 m in height and up to 1 m dbh. On favourable sites, it may attain 50 m in height and exceed 3 m dbh. Under forest conditions it is a tree of good form with a straight bole half or more of the tree height, with a well-developed crown.

Yellow stringybark occurs on coastal plains and adjacent ranges in south-eastern Australia from near Wollongong, New South Wales, in the north around to Wilsons Promontory in Victoria. It is quite common between Batemans Bay and Orbost.

This species prefers moist valleys and sheltered slopes of undulating and hilly country within 80 km of the coast, and is of restricted occurrence on exposed ridges and hilltops. It will grow on a wide range of soils but shows best development on fairly deep clay loams.

Yellow stringybark typically occurs in tall open eucalypt forests. It is rarely dominant and associated species include silvertop ash (*E. sieberi*), messmate (*E. obliqua*), white stringybark (*E. globoidea*) and mountain grey gum (*E. cypellocarpa*).

Related species: Brooker (2000) placed yellow stringybark in series *Pachyphloius*, a large group of rough-barked species endemic to eastern Australia. Yellow stringybark, which occurs near the coast south of Sydney and in eastern Victoria, may be associated with other stringybark species, but is distinguished by the rough bark to the small branches, discolorous adult leaves, and distinctly pedicellate buds and fruits. Only the first few pairs of seedling leaves are pubescent. The other common stringybark with distinct pedicels is silvertop stringybark (*E. laevopinea*), which occurs on the Central and Northern Tablelands of New South Wales and north to the Consuelo Tableland in Queensland, is easily recognised by the smooth bark on the upper branches. The seedlings are pubescent for more leaf pairs.

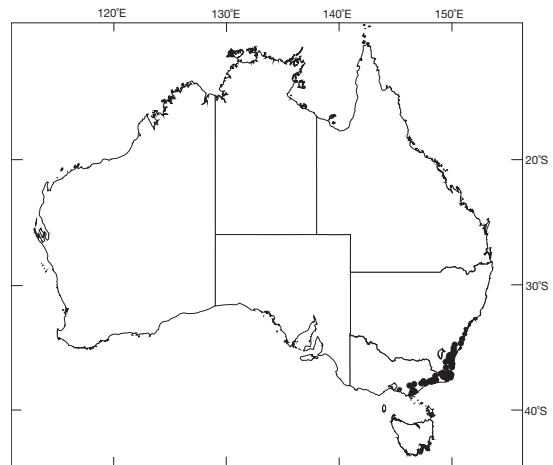
Publication: *Trans. Roy. Soc. Vic.* 2, 89 (1890). Type: Nine Mile Creek, south Gippsland, Victoria, A.W. Howitt 6.

Names: Botanical honours F. von Mueller (1825–1896), the most prominent of the 19th century botanists in Australia. Common refers to the heartwood colour and bark type.

Bark: Stringybark, persistent to the smaller branches, long pitted, thick, grey-brown.

Leaves: Seedling opposite for a few pairs then alternate, petiolate, ovate to broad-lanceolate, 5–14 × 2.2–4.5 cm, green, discolorous, with stellate hairs on leaf edges, veins and stems. Juvenile alternate, more or less horizontal, petiolate, ovate, often oblique, 12–16 × 4–5 cm, green, slightly to distinctly discolorous, early leaves hairy, later leaves glabrous. Intermediate alternate, petiolate, broad-lanceolate, oblique, 12–20 × 2.7–5 cm, green, slightly to distinctly discolorous. Adult alternate, petiolate, broad-lanceolate to lanceolate, 8–13 × 1.5–2.5 cm, slightly glossy, green, slightly to distinctly discolorous.

Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles angular to distinctly flattened, 0.8–1.8 cm long; pedicels



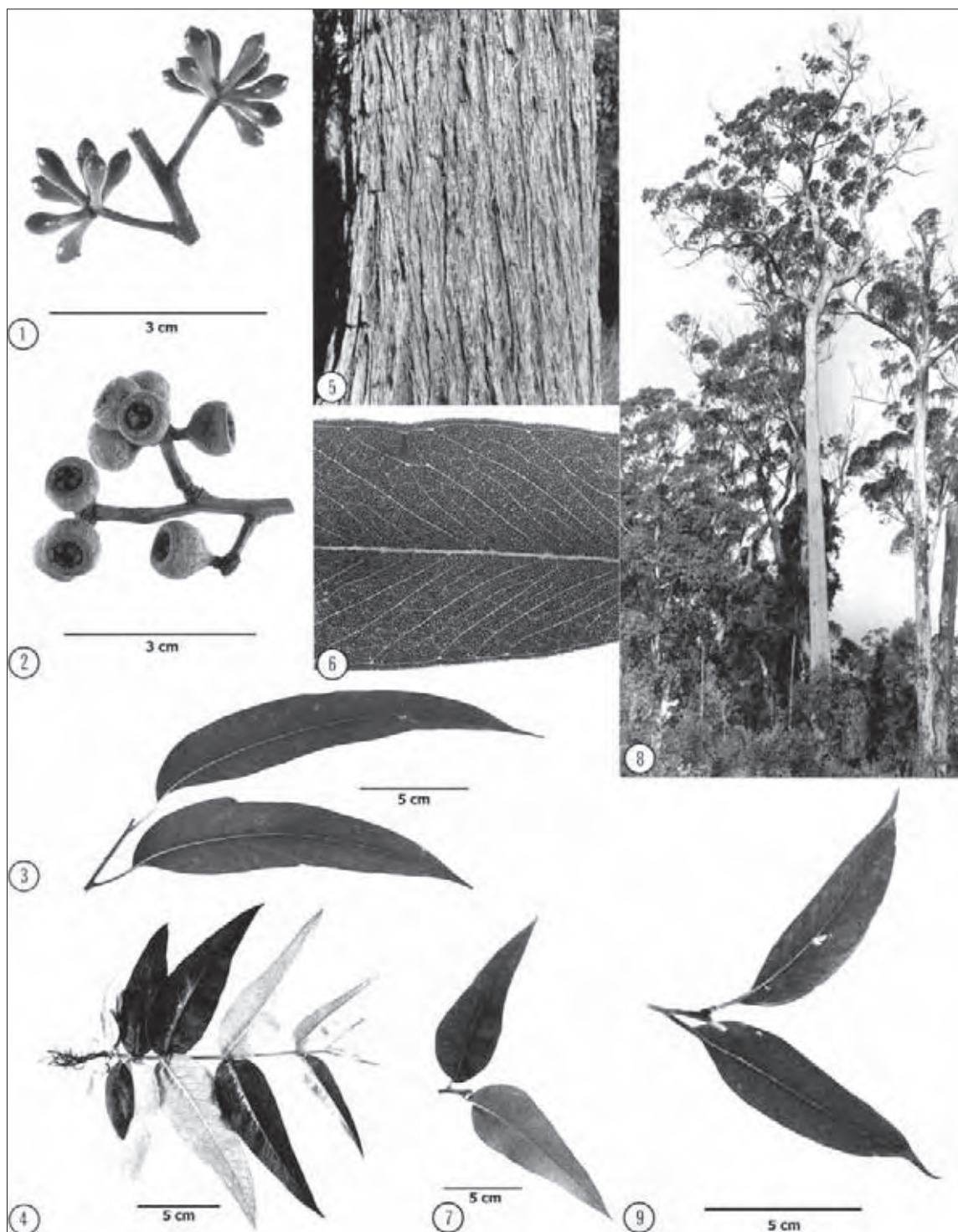
0.1–0.3 cm long; buds ovoid to clavate, 0.6–0.7 × 0.3–0.4 cm; opercula hemispherical to conical. Flowers Nov.–Mar.

Fruits: Pedicellate, subglobose to truncate-ovoid, 0.7–1 × 0.8–1.2 cm; disc broad, level to slightly descending, though occasionally slightly ascending; valves 4, slightly enclosed to slightly exserted. Seeds pyramidal or obliquely pyramidal, brown-black, hilum terminal.

Wood: Sapwood very pale brown, to 2.5 cm thick, rarely attacked by *Lyctus* borers; heartwood light yellow-brown, heavy, hard, moderately coarse-textured, grain generally interlocked, strong and moderately durable; density 730–975 kg m⁻³, used for general purpose construction, wharves, flooring, posts, poles, bridge timbers and railway sleepers. Wood very similar to white stringybark (*E. eugenioides*)—see Ilic (2002).

Climate: Altitudinal range: near sea level to 600 m; Hottest/coldest months: 24–28°C/1–6°C; Frost incidence: low to moderate (up to 20 or more each year with some snow at high elevations); Rainfall: 700–1200 mm per year, uniform to summer max.

Distinctive features: A tall stringybark tree of well-watered sites; all leaves discolorous; buds and fruits distinctly pedicellate.



Eucalyptus muelleriana 1. Buds 2. Fruits 3. Intermediate leaves 4. Seedling 5. Bark 6. Adult leaf venation 7. Juvenile leaves 8. Tree, Naghi State Forest, south of Eden, N.S.W. 9. Adult leaves

Silvertop Stringybark

Eucalyptus laevopinea R.T. Baker

Silvertop stringybark is a tall tree on favourable sites where it may be up to 40 m high and 1 m dbh. On poorer sites and drier situations it is reduced to a medium-sized tree around 20 m tall. It is usually of good form, with a straight bole, which may be more than half the total tree height.

Silvertop stringybark occurs from near Rylstone in the south, northwards throughout the Northern Tablelands of New South Wales and into adjacent areas of Queensland such as east of Warwick. There are disjunct populations on the Consuelo and Buckland Tablelands to the north-west of its main distribution in Queensland.

This species is found on undulating to hilly sites on the tablelands and on the higher ridges of the coastal escarpment. Best growth is on basaltic soils, but it also grows on moderately poor granitic soils provided there is some reasonably well-drained clay in the subsoil.

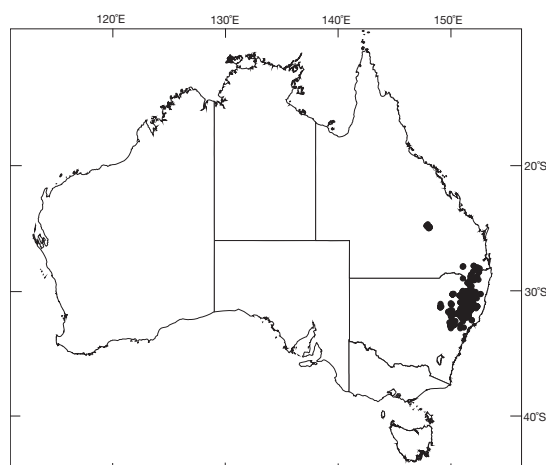
Silvertop stringybark occurs in open or tall open forests, in good quality stands, as one of the dominant species, with other eucalypts such as New England blackbutt (*E. andrewsii*) or messmate (*E. obliqua*). These forests are usually on the better quality sites. Other associated species may include Sydney blue gum (*E. saligna*), round-leaved gum (*E. deanei*), tallowwood (*E. microcorys*) and brown barrel (*E. fastigata*). In drier forests, with lower rainfall and poorer soils, there may be manna gum (*E. viminalis*), long-leaved box (*E. goniocalyx*), candlebark (*E. rubida*) and several stringybarks such as red stringybark (*E. macrorhyncha*), broad-leaved stringybark (*E. caliginosa*) and Diehard stringybark (*E. cameronii*).

Related species: Brooker (2000) placed silvertop stringybark in series *Pachyphloius*, a large group of rough-barked species endemic to eastern Australia. Silvertop stringybark may be associated with other stringybark species, but is distinguished by the smooth bark on the branches, distinctly pedicellate buds and fruits, obtusely conical opercula. The other common stringybark with distinct pedicels is yellow stringybark (*E. muelleriana*), which occurs from near Wollongong, New South Wales south to Wilsons Promontory in Victoria and has rough bark to the small branches, discoloured adult leaves, with seedlings pubescent for only a few pairs. Another species with smooth upper branches is Blaxland's stringybark (*E. blaxlandii*), which occurs on ranges from Nullo Mountain to Dampier State Forest in southern New South Wales, and has sessile buds with blunt opercula.

Publication: *Proc. Linn. Soc. N.S.W.* 23, 414 (1898). Syntypes: Nullo Mountain, near Rylstone, New South Wales, J. Dawson; Gulf Road N of Rylstone, New South Wales, Sep. 1895, R.T. Baker; Never Never Mtn, near Rylstone, New South Wales, R.T. Baker.

Names: Botanical Latin *laevus* (left), *pinus* (pine), referring to a property of the essential oil pinene, a constituent of the leaves of this species. Common refers to the smooth, whitish upper limbs which contrast with the stringybark on the rest of the tree.

Bark: Stringybark, moderately long p-bred and thick, p-bres criss-crossed beneath, outer layers longitudinally pssured,



outer bark grey, inner reddish brown; smaller limbs conspicuously smooth, whitish.

Leaves: Seedling N-opposite for 5 D 10 pairs then alternate, sessile for 4 or 5 pairs then shortly petiolate, ovate, 7 D 14 × 2 D 6.5 cm, green, discoloured; stellate hairs on stem and leaf edges (not as numerous as in other stringybark species). Juvenile N-alternate, petiolate, ovate, 13.5 D 17 × 4.5 D 7.5 cm, green, distinctly discoloured at prst soon grading to slightly discoloured, glabrous. Adult N-alternate, petiolate, lanceolate, often falcate and oblique, 9.5 D 14 × 1.5 D 2.5 cm, slightly glossy, green, concolorous.

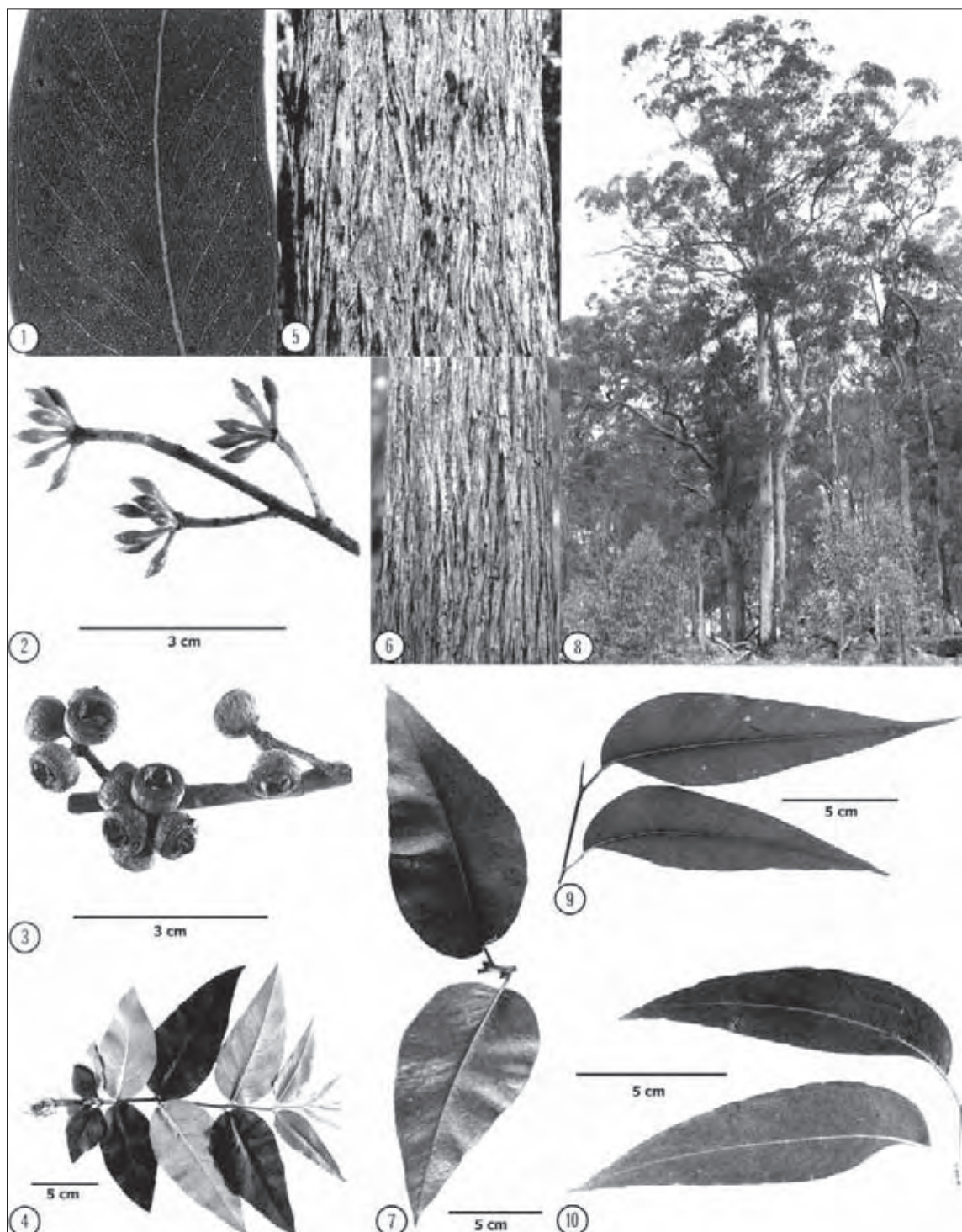
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles slightly angular to distinctly flattened, 0.5 D 2 cm long; pedicels 0.1 D 0.6 cm long; buds clavate to ovoid, 0.5 D 0.8 × 0.3 D 0.4 cm, opercula hemispherical-apiculate, conical or occasionally rostrate. Flowers Jun. D Aug.

Fruits: Pedicellate, hemispherical to subglobose (including the disc), 0.6 D 1.1 × 0.7 D 1.2 cm; disc very variable, broad and more or less level to very broad (approximately equal to the hypanthium), convex and ascending; valves 3 or 4, slightly enclosed to exserted. Seeds pyramidal or obliquely pyramidal, brown-black, hilum terminal.

Wood: Sapwood narrow, not susceptible to *Lyctus* borer attack; heartwood light brown, moderately P-ne-textured, grain usually straight, sometimes interlocked; density about 860 kg m⁻³, used for general building construction and has potential for plywood and veneer manufacture.

Climate: Altitudinal range: 750 D 1400 m; Hottest/coldest months: 25 D 28; C/ D 1 D 3; C; Frost incidence: moderate to high (40 D 70 each year with snow at high elevations); Rainfall: 800 D 1500 mm per year, summer max.

Distinctive features: A stringybark with the rough-barked trunk and larger limbs contrasting with the smooth, whitish upper limbs; buds and fruits smooth, pedicellate; disc very variable, level to ascending.



Eucalyptus laevopinea 1. Adult leaf venation 2. Buds 3. Fruits 4. Seedling 5. Bark, mature tree 6. Bark, younger tree 7. Juvenile leaves 8. Tree, Girard State Forest, near Tenterfield, N.S.W. 9. Intermediate leaves 10. Adult leaves

Red Stringybark

Eucalyptus macrorhyncha F. Muell. ex Benth.

Red stringybark attains 35 m in height under favourable conditions but on most sites is less than 20 m tall. The diameters are mainly up to 1 m dbh. The trunk is straight and varies from about one-third to two-thirds of the total height, while the crown is moderately dense with branchlets usually short, giving a rounded, rather compact crown.

Red stringybark is typically found on foothills, low-land ranges and undulating country. It is common throughout much of the foothill country of Victoria, especially on the lower northern slopes of the Great Dividing Range in the north-east of the State. In New South Wales it is common on the southern highlands, and occurs extensively on the southern and central western slopes to as far west as Warialda with outliers near Griffith (e.g. Mt Bingar), as well as on the Northern Tablelands. There is a small, disjunct occurrence in South Australia, south-west of Clare.

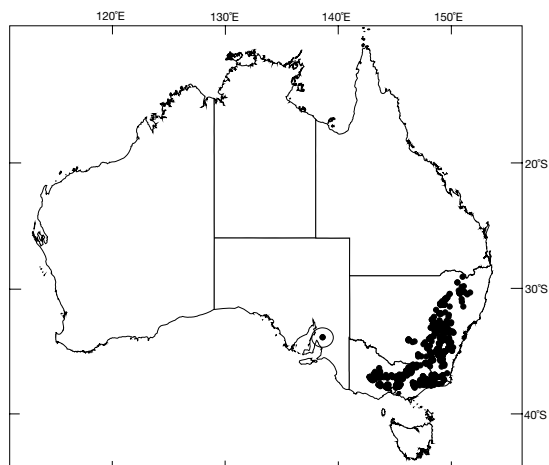
This species is found on various soils, mainly those of moderate fertility and of a clayey nature, but well drained.

Red stringybark does not form dense, pure stands but may be a dominant species in open forests or woodlands on parts of the tablelands and the upper western slopes of New South Wales, or along the lower northern slopes of the Great Dividing Range in Victoria. There is a large number of associated eucalypts including brittle gum (*E. mannifera*), scribbly gum (*E. rossii*) Blakely's red gum (*E. blakelyi*) and various boxes, especially red box (*E. polyanthemos*), long-leaved box (*E. goniocalyx*), and peppermints, notably broad-leaved peppermint (*E. dives*), and species of other genera including black cypress pine (*Callitris endlicheri*) and drooping sheoak (*Allocasuarina stricta*). In the South Australian occurrence, it grows with *E. goniocalyx* and *E. leucoxylon*.

Related species: Brooker (2000) placed red stringybark in series *Pachyphloius*, a large group of rough-barked species endemic to eastern Australia. Red stringybark should not be confused with any other stringybark as it occurs on the drier side of the distribution of the group, extending as far west as the low hills north of Griffith in south-western New South Wales. The buds are notably beaked and the fruits relatively large with a strongly domed disc. Note: *E. macrorhyncha* subsp. *cannonii* is a minor variant of very restricted distribution in the Ilford-Drystone-Capertee district of New South Wales, has slightly larger buds and fruits with a very prominent median flange.

Publication: *Fl. Austral.* 3, 207 (1867). Syntypes: Macalister River, Victoria, F. von Mueller; Near Mt Ligar, Victoria, Jan. 1863, F. von Mueller; Avon River, Victoria, Mar. 1854, F. von Mueller; Newfeld, Melbourne, Victoria, 9 May 1856, F. Adamson 471.

Names: Botanical Greek *macros* (large), *rhynchos* (beak), refers to the operculum. Common refers to the bark type and probably to the colour of the inner bark.



Bark: Stringybark persistent to the smaller branches, long barked and coarsely stringy, with deep longitudinal fissures, dark brown to greyish on the surface, reddish brown in under layers.

Leaves: Seedling Opposite for a few pairs then alternate, shortly petiolate, elliptical to ovate, 6.8 × 3.5 cm, green, discolorous; stellate hairs on stems, leaf edges and veins. Juvenile Alternate, petiolate, ovate, oblique, 8.12 × 3.5 cm, green, becoming concolorous and glabrous. Adult Alternate, petiolate, lanceolate, oblique, 9.14 × 1.2 cm, glossy green, concolorous.

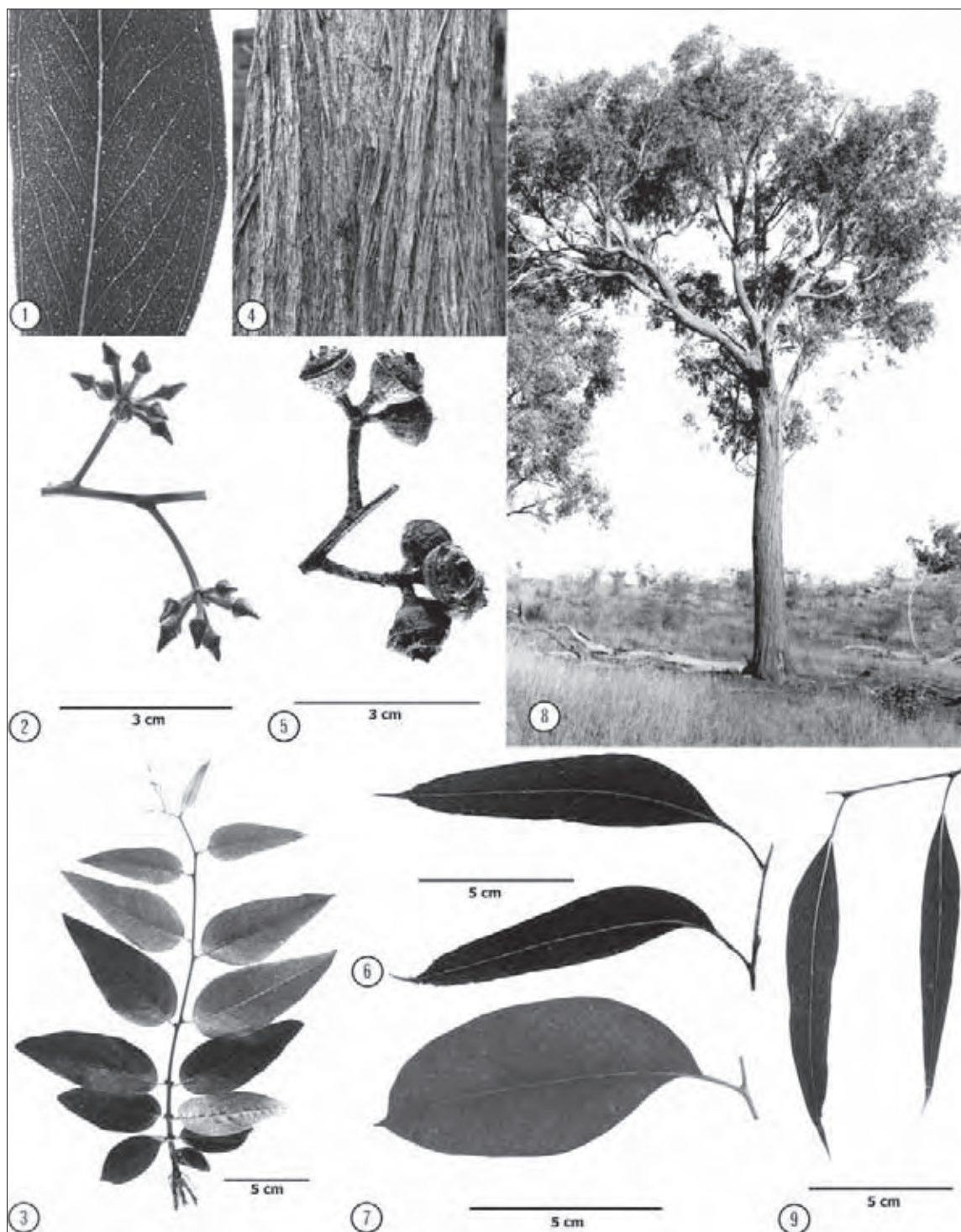
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles terete to angular or distinctly flattened, 0.7–1.6 cm long; pedicels 0.2–0.8 cm long; buds diamond-shaped; opercula beaked or less often conical. Flowers Jan.–Apr.

Fruits: Pedicellate, globose (including the disc), 0.6–1 × 0.7–1.2 cm; disc very broad (often equal to the hypanthium), convex, ascending; valves 3, broad-based, strongly exerted. Seeds pyramidal or obliquely pyramidal, brown-black, hilum terminal.

Wood: Sapwood pale brown, up to 5 cm wide, susceptible to attack by *Lyctus* borers; heartwood light but distinctly pink-brown, moderately fine to fine-textured, grain often interlocked, slow to dry, durable and termite resistant; density 635–955 kg m⁻³, used for general building construction and for fencing; has potential for warm-coloured flooring. For more information on distinguishing between red stringybark and woods of similar appearance, see Illic (2002).

Climate: Altitudinal range: 150–1000 m; Hottest/coldest months: 25–31°C/1–5°C; Frost incidence: moderate to high (5–70 per year with snow at high elevations); Rainfall: 800–1500 mm per year, winter to summer max.

Distinctive features: Coarse, deeply fissured stringybark; buds and fruits pedicellate; opercula beaked (rostrate), distinctly pointed; fruits top-shaped to subglobose, moderately large with a very broad disc.



Eucalyptus macrorhyncha 1. Adult leaf venation 2. Buds 3. Seedling 4. Bark 5. Fruits 6. Intermediate leaves 7. Juvenile leaf 8. Tree, Cotter Road, west of Canberra, A.C.T. 9. Adult leaves

Brown Stringybark

Eucalyptus baxteri (Benth.) Maiden & Blakely ex J.M. Black

Brown stringybark, in the better quality forests of eastern Victoria, is a good quality timber species 30–40 m tall and up to 1 m dbh. In more open forests on lowland country it is not so tall but often with comparable diameters. Except in the denser forests it tends to be heavily branched.

This species is common in western Victoria, where it occurs on hilly country in the Grampians and on undulating topography in the south-western corner, from which it extends into the south-eastern district of South Australia. East of Melbourne it is found scattered in the lower foothills of the Australian Alps and extends to the far south-eastern corner of New South Wales. In South Australia, it is also found in the hills south and east of Adelaide and on Kangaroo Island.

Its best development is on low hills and the plains of eastern Victoria and less often in mountainous areas. While showing better growth on fertile soils, it is also found on poor, whitish clayey soils of far south-eastern New South Wales.

Brown stringybark occurs in open forests or woodlands. On better sites is associated with species such as silvertop ash (*E. sieberi*) and messmate (*E. obliqua*). On the poorer sites it forms pure stands or may occur with cup gum (*E. cosmophylla*), soap mallee (*E. diversifolia*) and messmate stringybark.

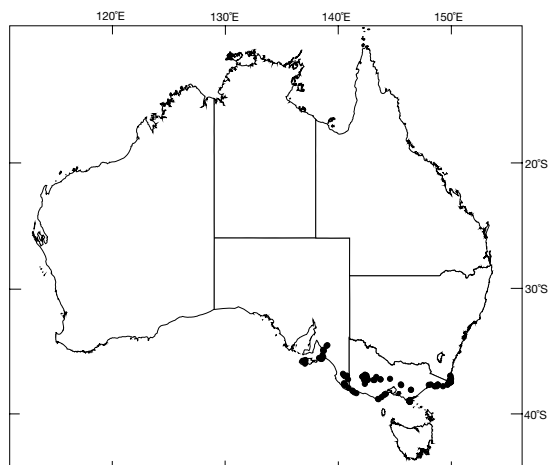
Related species: Brooker (2000) placed brown stringybark in series *Pachyphloius*, a large group of rough-barked species endemic to eastern Australia. Brown stringybark may occur near other rough-barked species but can be distinguished by the large, relatively thick, very glossy, green adult leaves and the more or less sessile buds with warty opercula. It is closely related to several other species, particularly the coarser-budded Grampians stringybark (*E. serraensis*) and Mt Abrupt stringybark (*E. verrucata*) of the Grampians region of western Victoria. North of the remote, far south-eastern New South Wales occurrence it is replaced by Illawarra stringybark (*E. imitans*), which occurs west of Nowra and differs by having a more pointed opercula and smaller fruits. Brown stringybark originally included the form var. *pedicellata* in the sandy country of the Upper South East of South Australia and east to north of the Grampians in the Little Desert of western Victoria. This species is now regarded as distinct (*E. arenacea*) by its consistent mallee habit, more pairs of juvenile leaves, narrower adult leaves and smaller, non-warty buds and smaller fruits.

Publication: *Fl. S. Aust.* Part 3, 415, J.M. Black (1926). Type: South Australia, W. Baxter, 1828. Cited as ÖS. coast, probably Kangaroo Island, Baxter (Herb. R. Br.)Ö.

Names: Botanical—after the collector of the type. Common—refers to heartwood colour and bark type.

Bark: Stringybark, persistent to the smaller branches, brown, long l-pred, thick, longitudinally furrowed (often obliquely around the trunk), grey.

Leaves: Seedling—opposite for 3–6 pairs then alternate, sessile to shortly petiolate, elliptical to ovate, 4–10.5 × 2.7–5.5 cm, green, slightly discoloured; stellate hairs on stems,



leaf edges and veins. Juvenile—alternate, petiolate, elliptical to ovate, often oblique, 7–13 × 4–8.5 cm, green, slightly discoloured to concolorous, glabrous. Intermediate—alternate, petiolate, ovate to broad-lanceolate, often oblique, 10–16 × 3.3–6 cm, thick, glossy green, concolorous. Adult—alternate, petiolate, broad-lanceolate, usually oblique, 7–12.5 × 2.5–5 cm, thick, glossy green, concolorous.

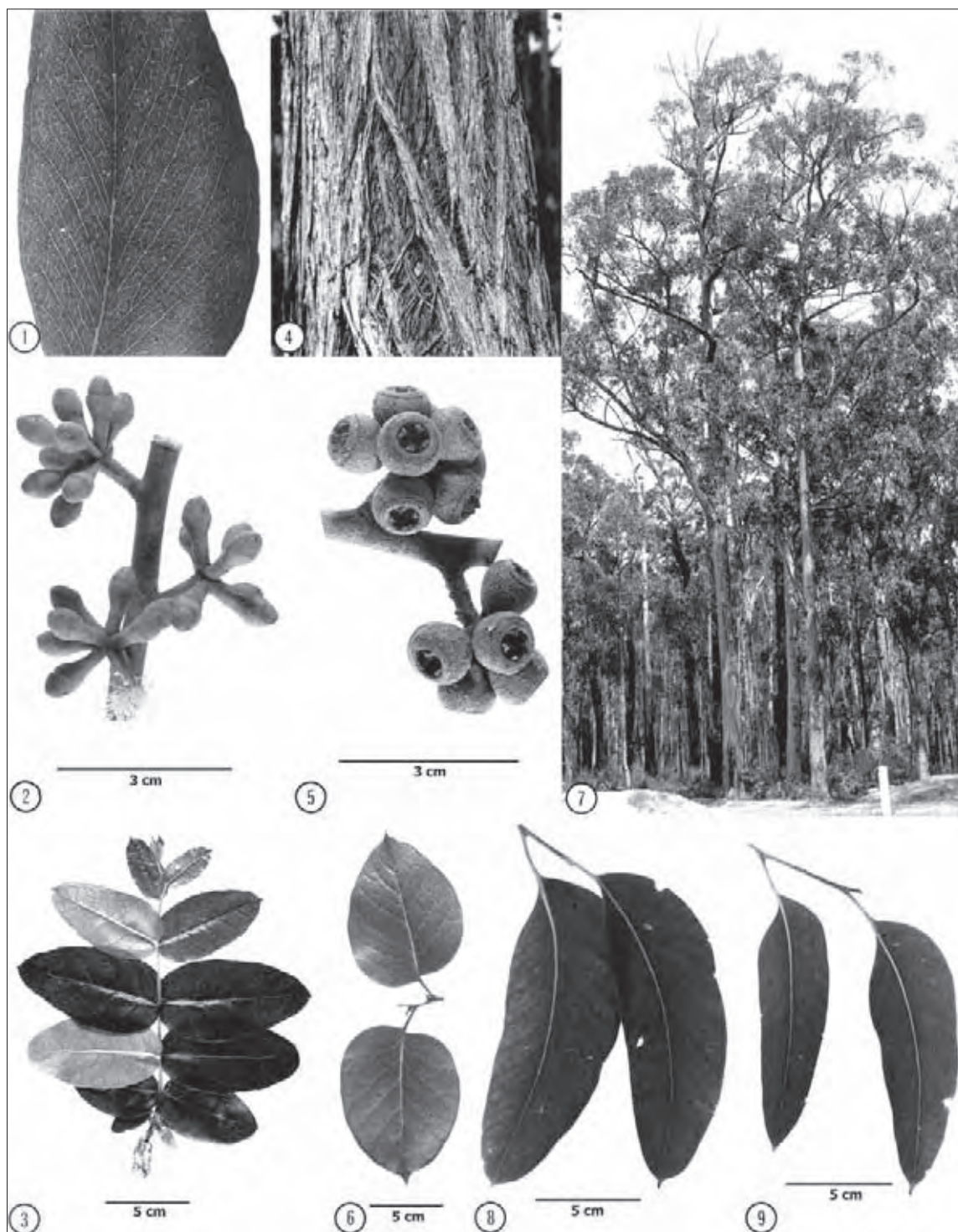
Inflorescences: Simple, axillary, 9 to 15-flowered; peduncles stout, terete to angular, 0.2–1.4 cm long; pedicels stout, to 0.4 cm long; buds clavate, 0.6–0.8 × 0.4–0.5 cm, warty; opercula hemispherical. Flowers Feb.–Mar.

Fruits: Sessile to shortly pedicellate, hemispherical to truncate-globose, 0.6–1.1 × 0.8–1.6 cm; disc broad to very broad, level to ascending; valves 4, short and stout, about rim level or exserted. Seeds pyramidal or obliquely pyramidal, brown-black, hilum terminal.

Wood: Sapwood rarely attacked by *Lyctus* borers; heartwood pale brown, hard, strong, tough, moderately durable, not termite resistant, of medium texture, straight or interlocked grain, kino (gum) veins frequent, relatively easy to work; density 580–900 kg m⁻³; used for structural engineering, railway sleepers, general building, fences. For more information on distinguishing between brown stringybark and woods of similar appearance, see Ilic (2002).

Climate: Altitudinal range: near sea level to 1100 m; Hottest/coldest months: 24–30°C/2–8°C; Frost incidence: low to moderate (up to 20 each year at high elevations); Rainfall: 500–1100 mm per year, winter max.

Distinctive features: Stringybark tree or mallee; leaves broad-lanceolate, glossy, thick, oblique; inflorescences 9 to 15-flowered; peduncles thick; pedicels absent to very short; buds warty; fruits to 1.6 cm diameter, disc prominent, level or ascending.



Eucalyptus baxteri 1. Adult leaf venation 2. Buds 3. Seedling 4. Bark 5. Fruits 6. Juvenile leaves 7. Stand, near Cabbage Tree, Vic. 8. Intermediate leaves 9. Adult leaves

Blue-leaved Stringybark

Eucalyptus agglomerata Maiden

Blue-leaved stringybark attains a maximum height of about 40 m and dbh up to 1 m on optimum sites, with good soils and suitable soil moisture. When growing on poorer sites it is only a tree of medium size, 25 m in height and 0.6 m dbh. In common with most of this group of stringybarks, the main stem is usually of good form, even on rather poor sites. When growing under rather open conditions it may retain branches to near ground level.

This species is one of the main stringybarks of the Central Tablelands, Central Coast as far as the Hunter River (e.g. in the Watagan Hills) and northern half of the South Coast of New South Wales. It extends into far eastern Victoria as far as Wangarabell. It grows mainly within 120 km of the sea.

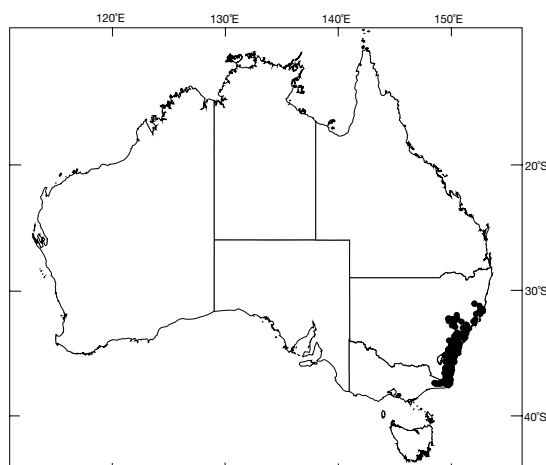
The tree is most commonly found on gentle to moderate slopes of tablelands and coastal areas, but it also grows on the steeper slopes of the Blue Mountains (Central Tablelands) and on the escarpment where the tablelands break away to coastal lowlands. Soils show a wide range, including those of a poor nature but with adequate soil moisture. Most of these are duplex soils showing strongly differentiated profiles but for optimum growth, moderately good loamy soils are necessary. Parent rock material is mainly sedimentary, usually shales and sandstones and sometimes slates.

Blue-leaved stringybark is mainly a species of open eucalypt forests often growing in association with narrow-leaved peppermint (*E. radiata*), Sydney peppermint (*E. piperita*), grey gum (*E. punctata*), silvertop ash (*E. sieberi*), yellow stringybark (*E. muelleriana*), yertchuk (*E. consideniana*), red bloodwood (*E. gummifera*) and also rough-barked apple (*Angophora floribunda*).

Related species: Brooker (2000) placed this species in series *Pachyphloius*, a large group of rough-barked species endemic to eastern Australia. Blue-leaved stringybark may occur near other rough-barked species but can be distinguished by the bluish crown of adult leaves, seen especially in slanting sunlight particularly in a breeze, and the very crowded distorted fruits. Another stringybark with crowded fruits, *E. blaxlandii*, distributed from the Central Tablelands south to Dampier State Forest in southern New South Wales, differs in the smooth branches and green crown. Orbost stringybark (*E. mackintii*), endemic to a small area in Victoria from Lakes Entrance east to near the border with New South Wales, also has a bluish crown but has larger, uncrowded fruits. White stringybark (*E. globoides*) differs in having a prolonged juvenile state of broadish, pubescent leaves (seen also as coppice), green crown of adult leaves and the almost sessile fruits, which are not crowded and distorted as in blue-leaved stringybark.

Publication: *J. & Proc. Roy. Soc. N.S.W.*, 55, 266 (1921). Type: Hill Top, New South Wales, Jan. 1896, J.H. Maiden.

Names: Botanical Latin *agglomeratus* (collected into a head), referring to the buds and fruits. Common refers to the bluish appearance of the canopy from a distance and to the bark type.



Bark: Stringybark, persistent to the smaller branches, long pbed, thick, prm, furrowed, grey over dark red-brown.

Leaves: Seedling opposite for 3 pairs then alternate, petiolate, ovate, 6.13 × 3.57 cm, green, discolorous; stellate hairs numerous on stems, leaf edges and veins. Juvenile alternate, petiolate, ovate, becoming oblique, 10.15 × 4.56 cm, green, becoming concolorous and glabrous.

Intermediate alternate, petiolate, broad-lanceolate, often oblique, 12.16.5 × 2.55 cm, green to bluish green, concolorous. Adult alternate, petiolate, broad-lanceolate to lanceolate, usually oblique, 7.512 × 1.43 cm, slightly glossy, green to bluish green, concolorous.

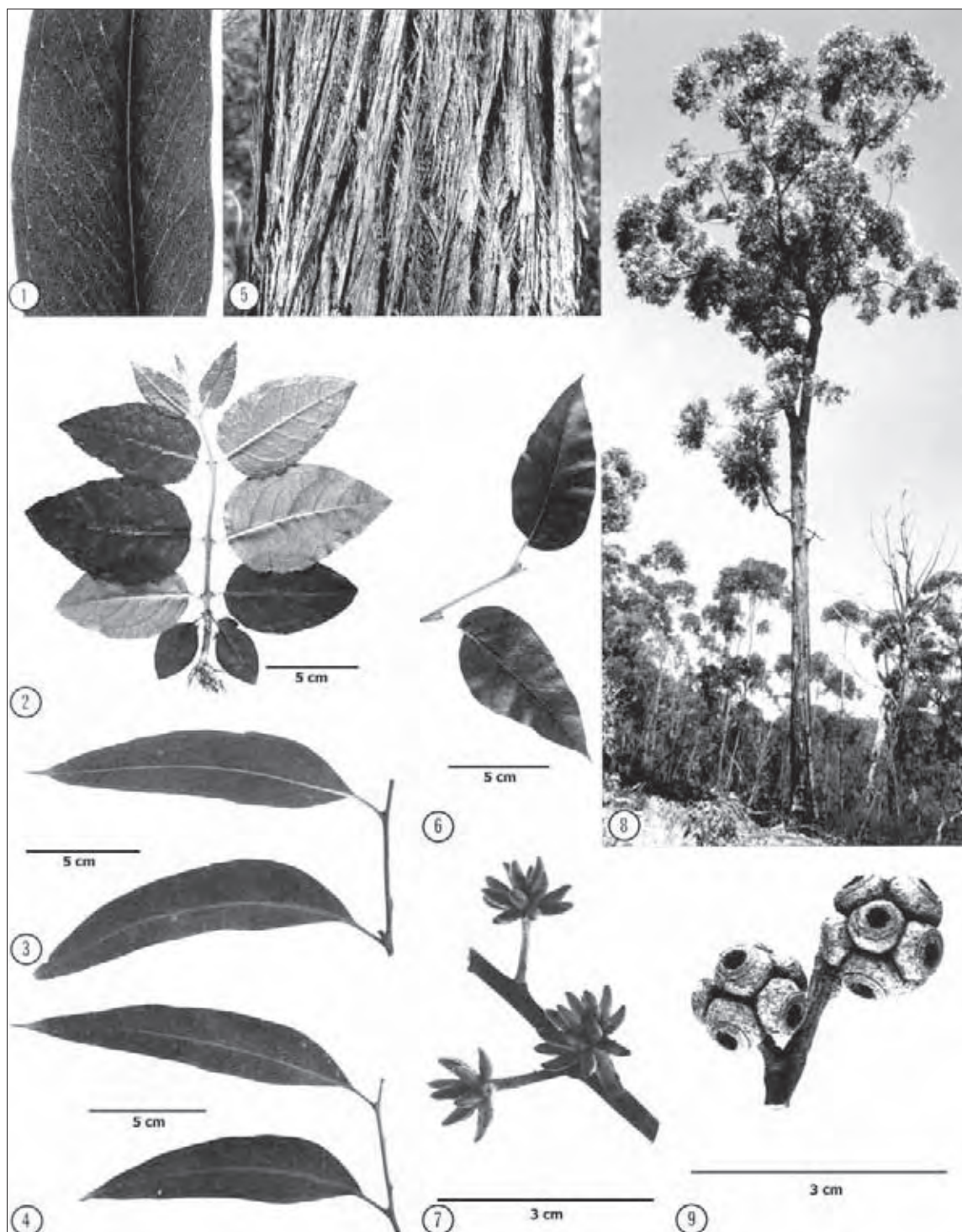
Inflorescences: Simple, axillary, 11 or more flowered; peduncles angular to flattened, 0.61.3 cm long; pedicels absent; buds fusiform, 0.70.8 × 0.3 cm; opercula conical, conical. Flowers Mar.–Aug.

Fruits: Sessile, globose to depressed-globose, with sides flattened, 0.40.6 × 0.51 cm; orbi small; disc relatively broad, level to slightly ascending; valves (3)4, to rim level or slightly enclosed. Seeds pyramidal or obliquely pyramidal, brown-black, hilum terminal.

Wood: Sapwood pale brown, resistant to attack by *Lyctus* borers; heartwood light brown, moderately pne-textured, some interlocked grain, slow drying; basic density about 600 kg m⁻³ (calculated air-dry density 725 kg m⁻³) used for general building construction and for fencing.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest months: 2531°C/266°C; Frost incidence: moderate to high (up to 80 each year at high elevations and inland sites); Rainfall: 7001150 mm per year, uniform to summer max.

Distinctive features: Medium-sized to tall tree; persistent, thick, furrowed stringybark; canopy bluish from a distance; inflorescences 11 to many flowered; buds and fruits sessile, usually in crowded heads, sides of fruits flattened due to crowding; opercula elongated, conical.



Eucalyptus agglomerata 1. Adult leaf venation 2. Seedling 3. Intermediate leaves 4. Adult leaves 5. Bark 6. Juvenile leaves 7. Buds 8. Tree, west of Bodalla, N.S.W. 9. Fruits

Thin-leaved Stringybark

Eucalyptus eugenoides Sieber ex Sprengel

Thin-leaved stringybark is typically 15–25 m in height, but attains 30 m in favourable locations. The trunk is generally straight and up to 0.7 m dbh, while the crown is well-branched and moderately dense. In open-growing trees the lower lateral branches are often persistent and retain foliage to a low level.

This species is one of the common eucalypts of the coast and some of the adjacent tablelands of New South Wales, especially the Central Tablelands, but may be absent from the higher altitudes. The species extends north from Wyndham in the far south-east of New South Wales, to south-west, south and east of Warwick in south-eastern Queensland, with disjunctions north of Toowoomba and several localities as far as Kroombit Tops near Gladstone, where the form is not quite typical.

The tree grows on coastal lowlands and adjacent hilly country and tablelands. Soils are typically those derived from shales and slates and are usually moderately fertile especially on the gently undulating topography of the coastal lowlands.

Thin-leaved stringybark occurs in open eucalypt forests often associated with forest red gum (*E. tereticornis*), grey gum (*E. punctata*), spotted gum (*E. maculata*), narrow-leaved red ironbark (*E. crebra*), manna gum (*E. viminalis*) and Argyle apple (*E. cinerea*). On poorer and more freely drained soils thin-leaved stringybark may be replaced by other stringybarks, for example, narrow-leaved stringybark (*E. sparsifolia*) on the Central Coast and Central Tablelands of New South Wales.

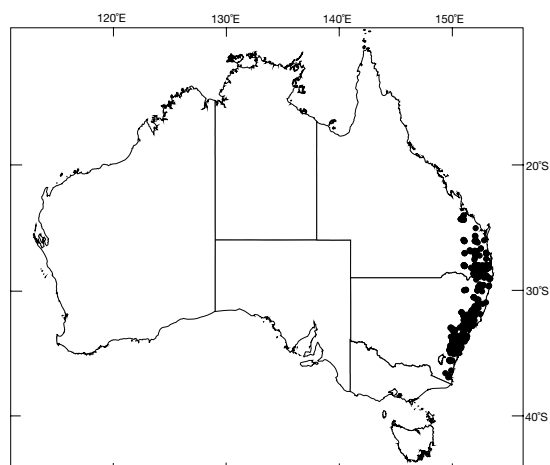
Related species: Brooker (2000) placed this species in series *Pachyphloius*, a large group of rough-barked species endemic to eastern Australia. Thin-leaved stringybark may occur near other rough-barked species but can be distinguished by the relatively narrow, thin, green adult leaves and the distinctly pedicellate buds and fruits. It is closely related to several other species, particularly blue-leaved stringybark (*E. agglomerata*) which differs by the bluish crown and crowded fruits and white stringybark (*E. globoides*) which differs by the more pairs of pubescent juvenile leaves, broader adult leaves and smaller, more crowded fruits. Isolated occurrences of the stringybark on the Consuelo and Buckland Tablelands, previously attributed to thin-leaved stringybark, are now considered to represent silvertop stringybark (*E. laevopinea*). A nearby related species, *E. erosa*, from Mt Moffat was recently described by Bean (2005).

Publication: *Syst. Veg.* 4, *Cur. Post.* 195 (1827). Type: \O New Holland \O , 1823, F.W. Sieber 479.

Names: Botanical— with some apparent similarity to *Eugenia*, another genus of the family Myrtaceae. Common— refers to the comparatively thin leaves (a rather variable feature) and to the bark type.

Bark: Stringybark, persistent to the small branches; long \P bred, thick, longitudinally \P ssured, grey to brownish.

Leaves: Seedling— opposite for 2–5 pairs then alternate, shortly petiolate, ovate, 5–10.5 \times 2.5–4.5 cm, dark green,



discolorous; stellate hairs occur on stems, leaf edges and veins. Juvenile— alternate, petiolate, ovate, oblique, 9.5–11 \times 4.5–6 cm, dark green, discolorous, early leaves with hairs, later leaves glabrous. Intermediate— alternate, petiolate, broad-lanceolate, usually oblique, 10–14 \times 2.5–3.3 cm, green, almost concolorous. Adult— alternate, petiolate, lanceolate, usually oblique, 8–12.5 \times 1.1–2.5 cm, glossy green, concolorous or very slightly discolorous.

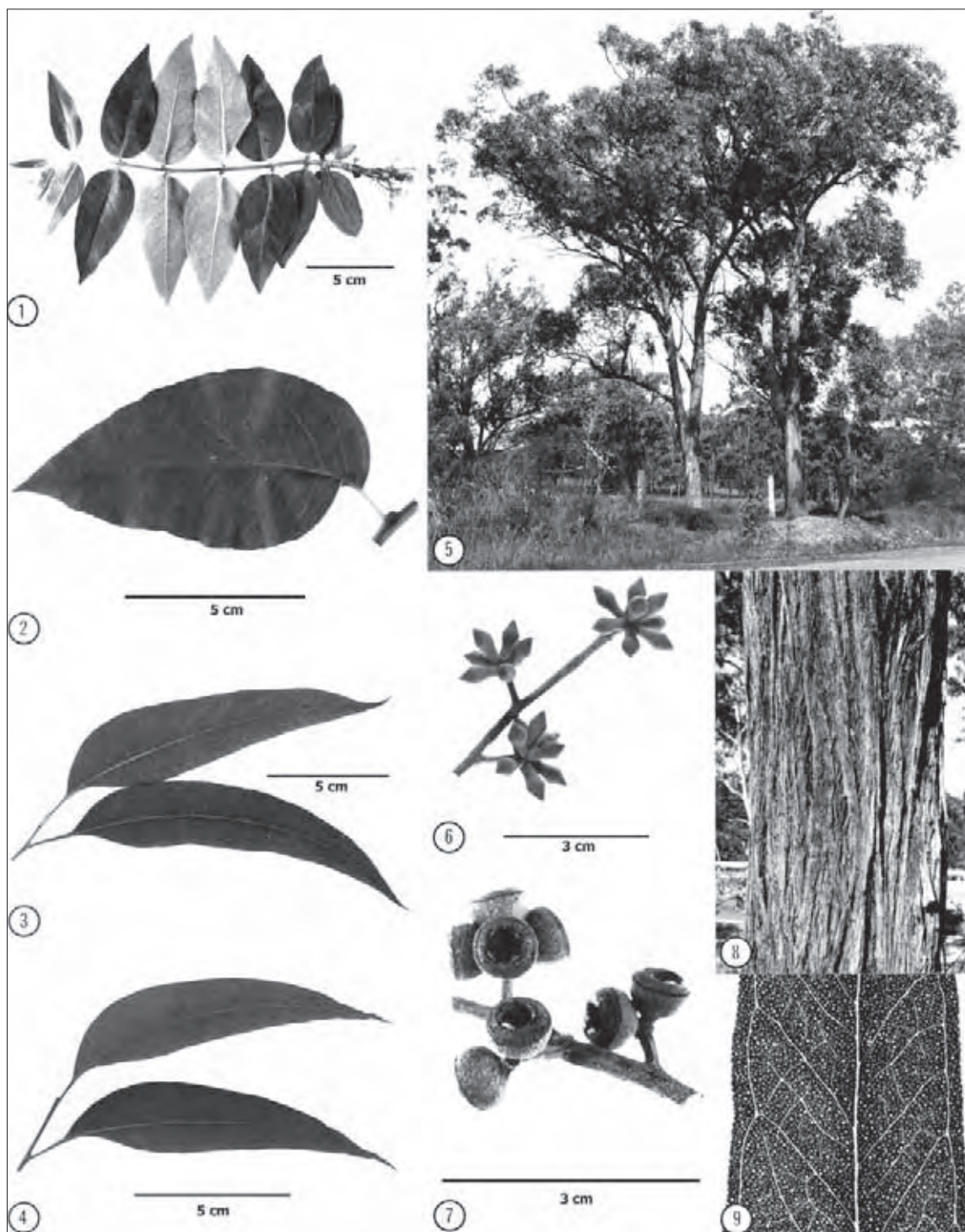
Inflorescences: Simple, axillary, 7 to 15-flowered; peduncles angular to flattened, 0.6–1.6 cm long; pedicels generally 0.2–0.5 cm long; buds broadly fusiform, 0.5–0.7 \times 0.2–0.4 cm; opercula conical. Flowers Sept.–Nov.

Fruits: Shortly pedicellate or rarely sessile, hemispherical or globose to truncate-globose, 0.4–0.8 \times 0.5–0.9 cm; disc relatively broad, level to slightly ascending, occasionally descending; valves (3) 4, about rim level or slightly exerted, occasionally enclosed. Seeds pyramidal or obliquely pyramidal, brown-black, hilum terminal.

Wood: Comparable to that of white stringybark (*E. globoides*), i.e. sapwood resistant to attack by *Lyctus* borers; heartwood light brown (occasionally light pink), moderately \P ne-textured, generally straight-grained; density 710–920 kg \P^3 , used for general building construction. Wood very similar to yellow stringybark (*E. muelleriana*)— see Ilc (2002).

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest months: 25–33 \P C/0–6 \P C; Frost incidence: low to high (up to 50 each year at high elevations); Rainfall: 700–1100 mm per year, uniform to summer max.

Distinctive features: A stringybark with pedicellate buds and fruits, adult leaves rather narrow and thin for a stringybark; disc of fruits usually prominent.



Eucalyptus eugenioides 1. Seedling 2. Juvenile leaf 3. Intermediate leaves 4. Adult leaves 5. Trees, near Springwood, N.S.W. 6. Buds 7. Fruits 8. Bark 9. Adult leaf venation

Tindale's Stringybark

Queensland White Stringybark, Queensland Stringybark, Pink Blackbutt, Black Stringybark

Eucalyptus tindaliae Blakely

Tindale's stringybark is usually a medium-sized to tall tree of good form, up to 35 m in height and 1 m dbh on good sites.

This species is one of the more common stringybarks of south-eastern Queensland occurring south from Maryborough to far northern New South Wales, especially in the Grafton–Lismore area.

Tindale's stringybark is found typically on the moderate slopes of tablelands and ranges. It grows on a wide range of soils from hard gravels to sandy loams, but best development is on better quality loams over clay with good but not excessive drainage.

It usually grows in open forests associated with many other eucalypt species of the coastal slopes and ranges, rarely becoming the dominant species. Some eucalypts with which it is often found are white mahogany (*E. acmenoides*), pink bloodwood (*E. intermedia*), grey gum (*E. major*), variegata (*E. citriodora* subsp. *variegata*) and red mahogany (*E. resinifera*).

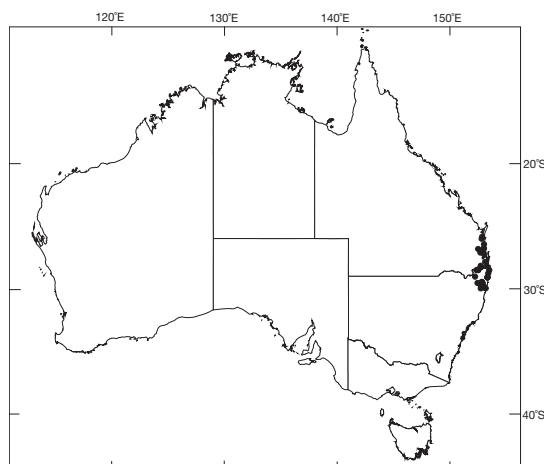
Related species: Brooker (2000) placed this species in series *Pachyphloius*, a large group of rough-barked species endemic to eastern Australia. Tindale's stringybark may occur near other rough-barked species but can be distinguished by the slightly bluish crown of adult leaves and the prominent domed disc of the fruits. It is related to several other species, particularly *E. reducta* which occurs in far north Queensland (e.g. Windsor Tableland west of Daintree, near Helenvale, Atherton, Ravenshoe, Herberton and the Mt Spec–Paluma region). It differs in having smaller adult leaves, generally smaller buds and fruits, and the 3-valved fruits. Note that the treatment of Tindale's stringybark here includes *E. phaeotricha* and *E. nigra*, which are indistinguishable.

Publication: In Maiden, *Crit. Revis. Eucalyptus* 8, 61 (1929). Syntypes: near Copmanhurst, New South Wales, 28 Jul. 1922, W.F. Blakely & D.W.C. Shiress; Orara Creek, 16 km S of Ramornie, New South Wales, 28 Jul. 1922, W.F. Blakely & D.W.C. Shiress; ?Denman, New South Wales, Jan. 1909, W. Heron.

Names: Botanical honours Anne G. Tindale (1859–1928) who was a member of a pioneering pastoral family from the Casino–Grafton area of northern New South Wales with a keen interest in the flora of the region. Commonly the variety of names reflects the different perceptions in the two States of its occurrence.

Bark: Stringybark persistent to the smaller branches, long pitted, coarse, with broad longitudinal fissures, light grey-brown over light red-brown to orange.

Leaves: Seedling opposite for 4–7 pairs then alternate, sessile for 1–2 pairs then shortly petiolate, ovate, 5–11 × 3–5 cm, green, discolorous; numerous stellate hairs on stems, leaf edges and veins. Juvenile alternate, petiolate, ovate, becoming oblique, 6–11 × 3–5 cm, green, discolorous, hairy at first, later leaves becoming glabrous. Seedling and early juvenile leaves undulate and with crenulate or toothed edges. Intermediate alternate, petiolate, ovate to broad-lanceolate, usually oblique, 8–15 × 2.5–4 cm, slightly discolorous.



Adult alternate, petiolate, broad-lanceolate to lanceolate, usually oblique, 8–12 × 1.3–2.8 cm, slightly glossy, green to bluish green, slightly discolorous.

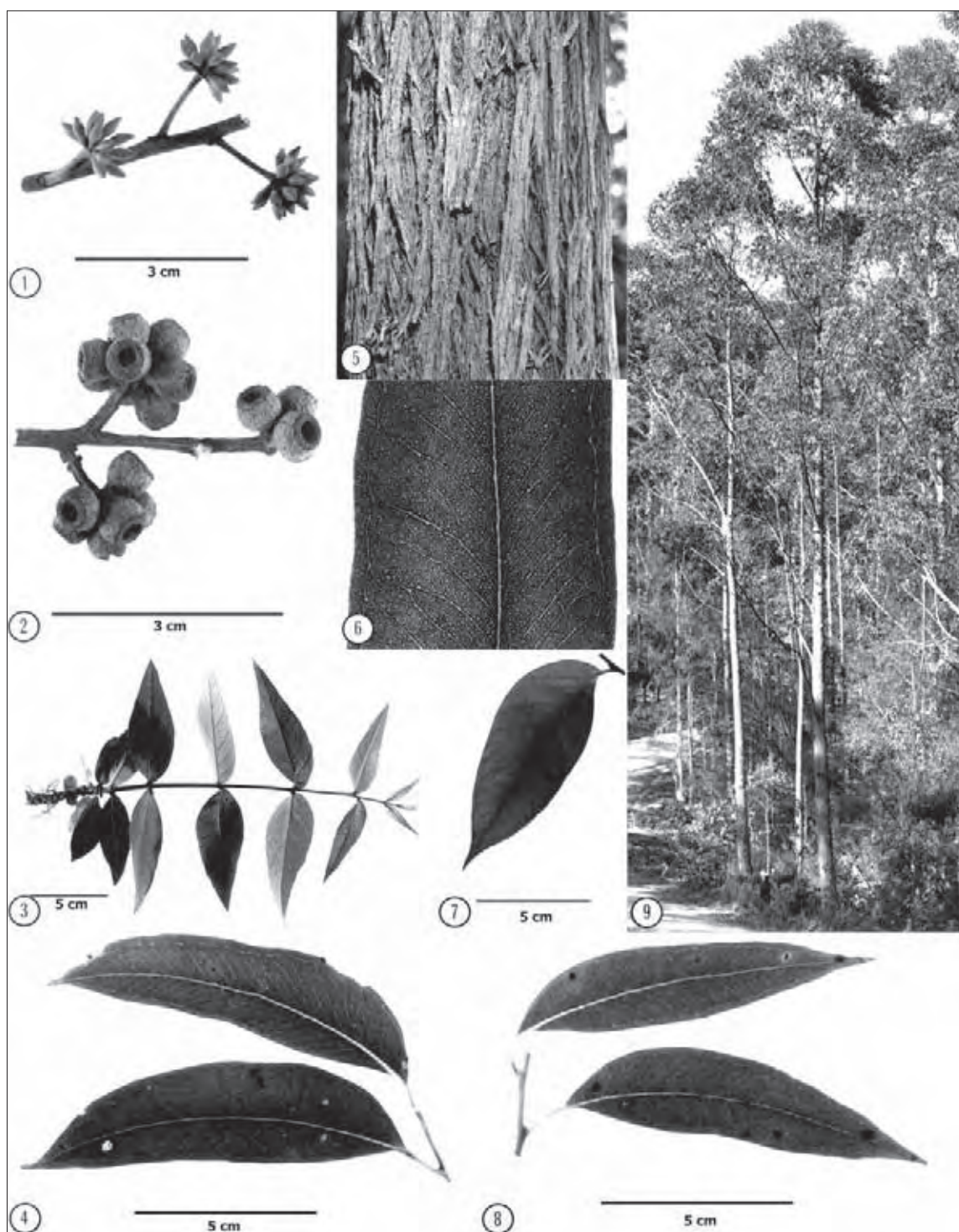
Inflorescences: Simple, axillary, 11 or more flowered; peduncles angular to flattened, 0.3–1.3 cm long; pedicels either absent or to 0.2 cm long; buds ovoid, 0.5–0.7 × 0.3–0.4 cm; opercula rounded or conical. Flowers Feb.–Jun.

Fruits: Sessile or occasionally very shortly pedicellate, hemispherical or truncate-globose, sometimes distorted by crowding, 0.4–0.7 × 0.6–1.1 cm; disc broad, convex, ascending, valves 3 or 4, broad-based, rim level or slightly exserted. Seeds pyramidal or obliquely pyramidal, brown-black, hilum terminal.

Wood: Heartwood pale brown to pale pink, fissile, strong and durable in the ground, subject to kino (gum) veins; density about 840 kg m⁻³; a first-class general construction timber used both for house framing and heavier building; also satisfactory for flooring and inside finish.

Climate: Altitudinal range: near sea level to 1050 m; Hottest/coldest months: 29–33°C/3–13°C; Frost incidence: low to moderate (at high elevations); Rainfall: 1000–2000 mm per year, summer max.

Distinctive features: At best a moderately tall tree with coarse stringybark; broad juvenile leaves; usually many-flowered; fruits mostly wider than long with a usually prominent, convex disc.



Eucalyptus tindaliae 1. Buds 2. Fruits 3. Seedling 4. Intermediate leaves 5. Bark 6. Adult leaf venation 7. Juvenile leaf 8. Adult leaves 9. Trees, Nullum State Forest, near Murwillumbah, N.S.W.

White Stringybark

Eucalyptus globoidea Blakely

White stringybark under favourable conditions attains 25–30 m in height and 1 m dbh with a straight trunk, which may be up to two-thirds of the tree height. Exceptional specimens exceed 40 m in height. On poor sites the height may be less than 15 m and the trunk short and of poor form. In coastal Victoria it can be a mallee. The crowns are usually compact and moderately dense.

This species is a common tree south from Kempsey in central and southern coastal New South Wales, and on the edges of the tablelands adjacent to the coastal areas in central and lower northern parts of the State, and also in Victoria, east and north-east from Melbourne.

It grows on various topographical sites from gently undulating country and hills near the coast to mountain slopes at the junction of the tablelands and the coastal areas. Soils are commonly sandy but the species also occurs on gravelly loams and clays and on skeletal soils.

White stringybark occurs in open eucalypt forests often associated with silvertop ash (*E. sieberi*), grey gum (*E. punctata*), yertchuk (*E. considiana*), Maiden's gum (*E. maidenii*), red bloodwood (*E. gummifera*), spotted gum (*E. maculata*), blackbutt (*E. pilularis*), woollybutt (*E. longifolia*) and red ironbark (*E. sideroxylon*).

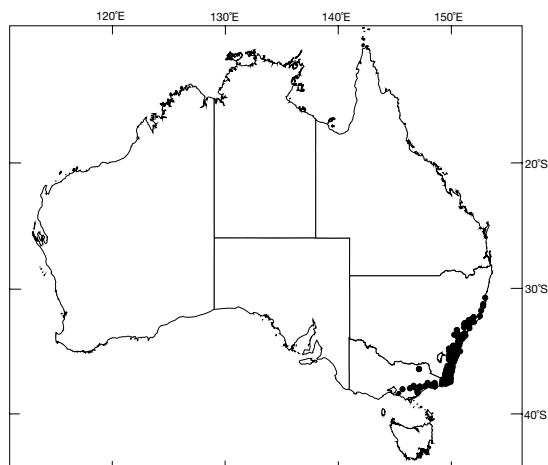
Related species: Brooker (2000) placed this species in series *Pachyphloius*, a large group of rough-barked species endemic to eastern Australia. White stringybark may occur near other rough-barked species but can be distinguished by the prolonged juvenile state of broadish, pubescent leaves (seen also as coppice), green crown of adult leaves and the almost sessile fruits which are not crowded and distorted as in blue-leaved stringybark (*E. agglomerata*), which has a bluish crown. In Victoria *E. globoidea* may grow near brown stringybark (*E. baxteri*), which differs by the broader, thicker adult leaves and blunt warty buds. White stringybark may be confused with thin-leaved stringybark (*E. eugenioides*), which is distinguished by the pedicellate buds and fruits.

Publication: *J. & Proc. Roy. Soc. N.S.W.* 61, 157 (1927). Type: Berrima, New South Wales, Sept. 1901, J.H. Maiden and J.L. Boorman.

Names: Botanical Latin *globoideus* (globe-shaped), of the fruits. Common refers to the light colour of the wood and to the bark type.

Bark: Stringybark persistent to the smaller branches, thick, long-lived, firm to slightly spongy, deep longitudinal, sometimes oblique furrows, criss-crossed and red-brown beneath, weathering to greyish.

Leaves: Seedling opposite for 4–7 pairs then alternate, shortly petiolate, ovate, 3.5–9 × 1.7–4.5 cm, dark green, discolorous. Juvenile alternate, petiolate, occasionally cordate, ovate, 6–10.5 × 2–6 cm, dark green, discolorous. Both seedling and early juvenile leaves are undulate and crenulate with stems, leaf edges and veins having numerous stellate hairs. Intermediate alternate, petiolate, broad-lanceolate, 11–14 × 2.5–4 cm, green, concolorous or sometimes very slightly discolorous. Adult alternate, petiolate, broad-lanceolate to lanceolate, usually oblique,



7.5–12.5 × 1.2–2.5 cm, glossy green, concolorous or very slightly discolorous.

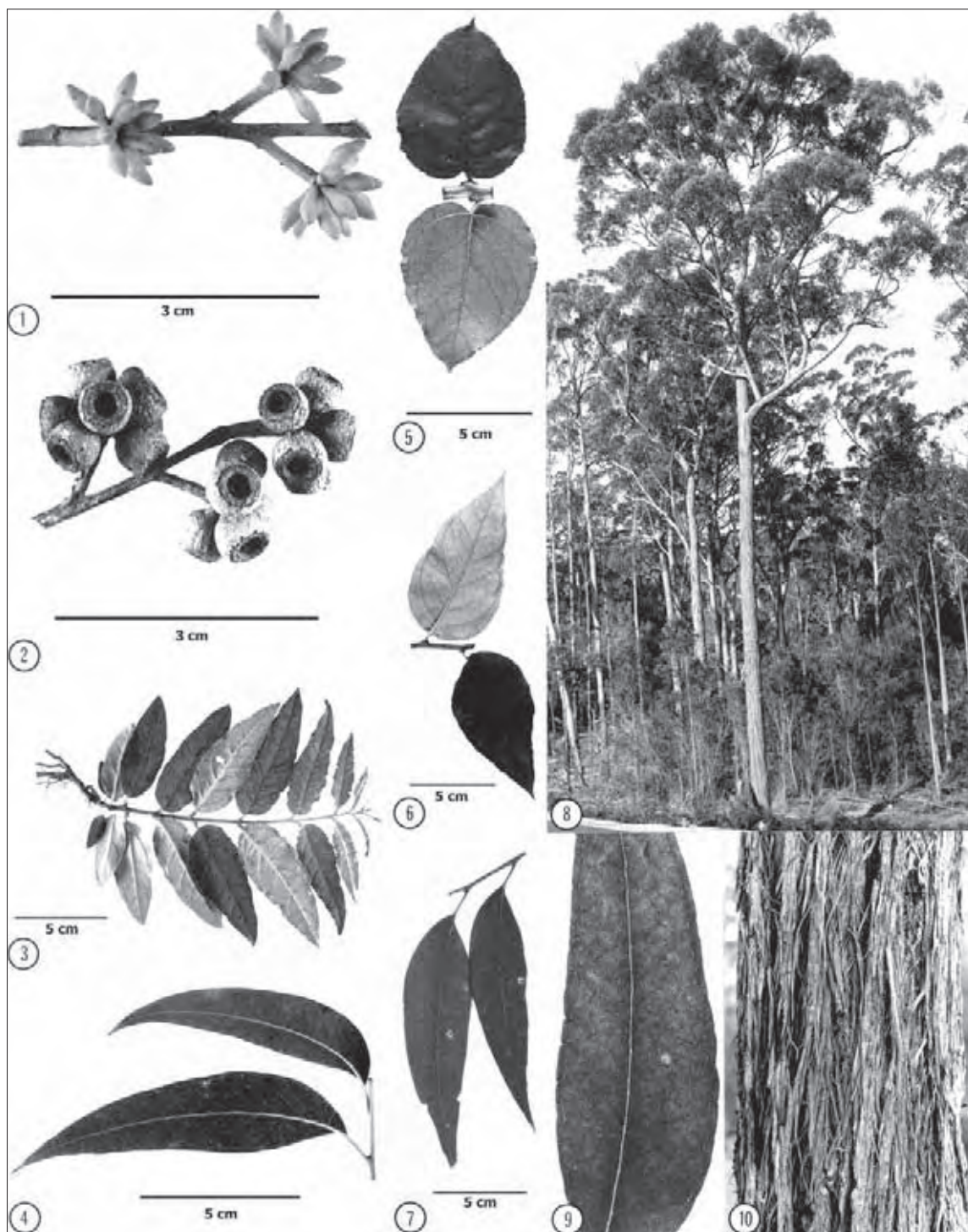
Inflorescences: Simple, axillary (occasionally subterminal), 11 to 15-flowered; peduncles angular to flattened, 0.4–1.2 cm long; pedicels absent or to 0.2 cm long; buds broadly fusiform, 0.5–0.6 × 0.3–0.4 cm; opercula conical. Flowers Apr.–Jun.

Fruits: Sessile or very shortly pedicellate, hemispherical to truncate-globose, 0.4–0.7 × 0.6–1 cm, occasionally with flattened sides due to crowding; disc relatively broad, more or less level (varies from slightly descending to slightly ascending); valves 4, to rim level or slightly enclosed. Seeds pyramidal or obliquely pyramidal, brown-black, hilum terminal.

Wood: Sapwood resistant to attack by *Lyctus* borers; heartwood light brown, occasionally light pink, moderately fine-textured, generally straight-grained; density 640–830 kg m⁻³; used for general building construction. For more information on distinguishing between this species and woods of similar appearance, see Ilic (2002).

Climate: Altitudinal range: near sea level to 1100 m; Hottest/coldest months: 22–31°C/1–6°C; Frost incidence: low to high (up to 40 each year with snow at high elevations); Rainfall: 650–1400 mm per year, uniform to summer max.

Distinctive features: Medium-sized to tall tree; seedling and juvenile leaves with crenulate and undulate margins and tufts of fine stellate hairs on the underside and edges; long-lived stringybark; adult leaves glossy green; buds small, fusiform; fruits closely clustered, sessile or very shortly pedicellate.



Eucalyptus globoidea 1. Buds 2. Fruits 3. Seedling 4. Adult leaves 5, 6. Juvenile leaves 7. Intermediate leaves 8. Tree, south of Eden, N.S.W. 9. Adult leaf venation 10. Bark

Diehard Stringybark

Eucalyptus cameronii Blakely & McKie

Diehard stringybark is a medium-sized to tall tree; on favourable sites it attains 30–40 m in height and over 1 m dbh, with a straight trunk. In dense forest the crown is restricted to the upper half of the tree, but open-growing specimens are heavily branched from near ground level, and have a wide and dense crown.

This species grows on the Northern Tablelands of New South Wales, mainly on the eastern side from near the New England Highway to the edge of the coastal escarpment. This belt extends for about 300 km from close to the border with Queensland, to west of Gloucester; it is up to 100 km wide and in places approaches the coast.

Diehard stringybark grows on undulating topography and hills. Towards the ridge tops the soils are comparatively shallow, with rocks near the surface but are not typical skeletal, while on lower valley slopes they have higher humus and loam content and form relatively good forest soils. The prevailing rocks are granites, but shales are present in places.

This species occurs in open or tall open forests and on moister sites may be associated with species such as giant white gum (*E. nobilis*), blackbutt (*E. pilularis*) and, less commonly, narrow-leaved peppermint (*E. radiata*) and Sydney blue gum (*E. saligna*). On somewhat drier and better-drained areas there may be New England blackbutt (*E. andrewsii*) and several other stringybarks.

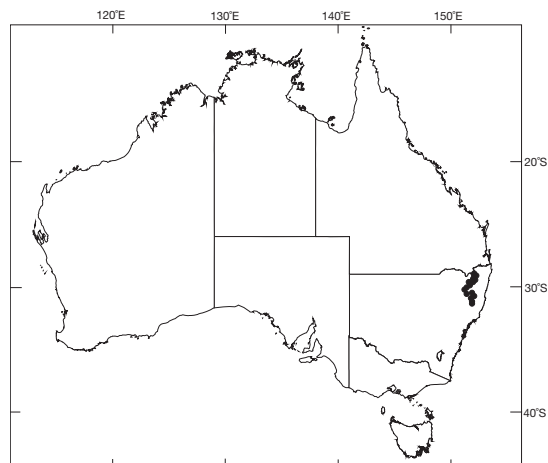
Related species: Brooker (2000) placed this species in series *Pachyphloius*, a large group of rough-barked species endemic to eastern Australia. Diehard stringybark is closely related to white stringybark (*E. globoidea*) and differs in the smaller buds and fruits. Other Northern Tableland stringybarks include McKie's stringybark *E. mckieana*, which differs in the narrower juvenile and adult leaves, blue-leaved stringybark (*E. agglomerata*), which differs in the bluish crown of adult leaves and the crowded fruits with flattened sides, and broad-leaved stringybark (*E. caliginosa*) which differs in having larger buds and fruits.

Publication: *Key to Eucalypts*, 180 (1934). Type: Diehard State Forest, about 25 miles east of Glen Innes, New South Wales, 28 Jun. 1932, E.N. McKie, A.P. Cameron and R.H. Luke.

Names: Botanical name after A.P. Cameron (1869–1945) one of the collectors of the type. Common name refers to the type area and the bark type.

Bark: Stringybark, persistent to the small branches, long fibred, longitudinal fissures shallow, narrow and close together, thin, grey to brownish grey.

Leaves: Seedling opposite for 5 or 6 pairs, then alternate, petiolate, ovate, 5–8 × 2–4.2 cm, green, discolorous, undulate, crenulate or toothed; stems, leaf edges and veins with numerous stellate hairs. Juvenile alternate, petiolate, ovate, later ones oblique, 5–8 × 3–4.5 cm, green, discolorous; gradually losing the undulate and crenulate edges and becoming glabrous. Intermediate alternate, petiolate, broad-lanceolate, usually oblique, 9–11 × 2.5–3.2 cm, green, slightly



discolorous. Adult alternate, petiolate, broad-lanceolate to lanceolate, usually oblique, 6.5–10 × 1.7–2.5 cm, green, concolorous or very slightly discolorous.

Inflorescences: Simple, axillary, 7 to many flowered; peduncles angular, 0.5–1 cm long; pedicels very short; buds broadly fusiform, 0.5–0.6 × 0.3 cm; opercula conical. Flowers Feb.–May.

Fruits: Sessile or very shortly pedicellate, truncate-globose or somewhat flattened, sometimes with slightly flattened sides due to crowding, 0.4–0.5 × 0.5–0.7 cm; disc relatively narrow, descending; valves 4, just below rim level. Seeds pyramidal or obliquely pyramidal, brown-black, hilum terminal.

Wood: Sapwood not easily distinguished, probably resistant to attack by *Lyctus* borers; heartwood light brown, moderately coarse-textured, strong and moderately durable, rather slow drying; density about 750 kg m⁻³; used for general building construction.

Climate: Altitudinal range: 100–1200 m; Hottest/coldest months: 25–29°C/0–3°C; Frost incidence: moderate to high (30–70 each year with snow at high elevations); Rainfall: 800–1500 mm per year, summer max.

Distinctive features: Medium-sized to tall tree; bark persistent to the small branches; seedling and juvenile leaves hairy and glandular, with slightly crenulate and undulate edges; small fusiform, more or less sessile buds and small, globose fruits with narrow, usually depressed discs and small valves just below rim level.



Eucalyptus cameronii 1. Buds 2. Fruits 3. Juvenile leaves 4. Intermediate leaves 5. Adult leaf venation 6. Seedling 7. Adult leaves 8. Tree, Forest Lands State Forest, near Tenterfield, N.S.W. 9. Bark

Blackdown Stringybark

Eucalyptus sphaerocarpa L.A.S. Johnson & D.F. Blaxell

Blackdown stringybark is a tall tree commonly up to 45 m in height with dbh to 1.5 m. The trunks are of good form and the size of the crowns varies with the density of the stand. On poor sites, however, the more open-growing trees may be only 25 m tall with large and moderately dense crowns.

This species is only known from the Blackdown Tableland of central, eastern Queensland, some 160 km west of Rockhampton. This is an elevated sandstone plateau with a remnant volcanic capping, about 13×24 km in extent, formed by the northern parts of the Dawson and Expedition Ranges.

The lowlands to the north of the area of occurrence are below 150 m in altitude and the tableland on which the species occurs rises abruptly from the plains to escarpments around 600 m altitude. The tableland comprises higher undulating country, rising to about 900 m in the north-eastern corner. On the better sites soils are loams, but towards the escarpment the soils are drier, rockier and in places almost skeletal.

In the central part of the tableland, Blackdown stringybark grows in tall open forests. There are several associated eucalypts, all of commercial quality and mainly in the height range of 30–40 m, viz. a white stringybark (*E. mensalis*), an ironbark (*E. melanoleuca*), Sydney blue gum (*E. saligna*), grey gum (*E. longirostrata*) and a form of white mahogany (*E. 'constricta'*), which has unusual urceolate fruits. On the drier edges there are several other species—Bailey's stringybark (*E. baileyana*), and bloodwoods (*E. clarksoniana* and *E. bunites*).

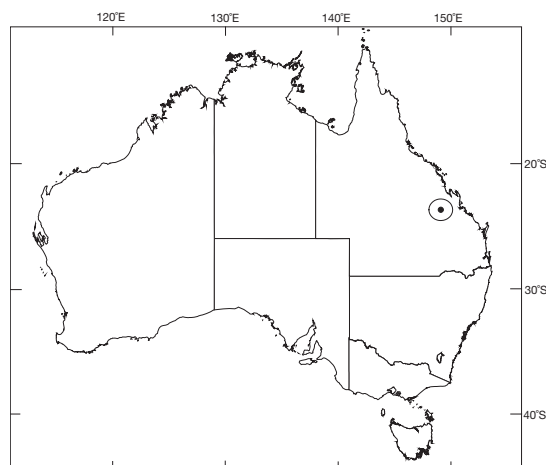
Related species: Brooker (2000) placed Blackdown stringybark in section *Cineraceae* but in its own series (*Sphaerocarpace*), as it is not closely related to any other species. It has affinities with the blue ash group with which it shares the distinctive, relatively large, petiolate, pendulous, bluish-green juvenile leaves. These are readily seen as regrowth in the field.

Publication: *Contr. N.S.W. Natl Herb* 4, 284 (1972). Type: Blackdown Tableland, Queensland, Aug. 1964, C.H. Gittins 932.

Names: Botanical—Greek *sphaera* (ball, globe), *carpos* (fruit), referring to fruit shape. Common—refers to the area of occurrence and to the bark (though not a true stringybark i.e. sect. *Capillulus*).

Bark: Rough and persistent to the smaller branches, relatively short-fibred and more compact than stringybarks, with shallow longitudinal fissures, grey to grey-brown, moderately thick.

Leaves: Seedling—sessile and opposite for several pairs then alternate, shortly petiolate, elliptical to ovate, $6.5\text{--}16 \times 2.7\text{--}5$ cm, bluish green, discolorous. Juvenile—alternate, petiolate, ovate to broad-lanceolate, $14\text{--}19 \times 4\text{--}6$ cm, bluish green, slightly discolorous. Intermediate—alternate, petiolate, broad-lanceolate, slightly oblique, $12.5\text{--}18 \times 2.6\text{--}4.5$ cm, greyish green, concolorous. Adult—alternate, petiolate,



lanceolate or falcate and slightly oblique, $9\text{--}14 \times 1.5\text{--}2.5$ cm, greyish green, concolorous. The canopies appear distinctly bluish from a distance.

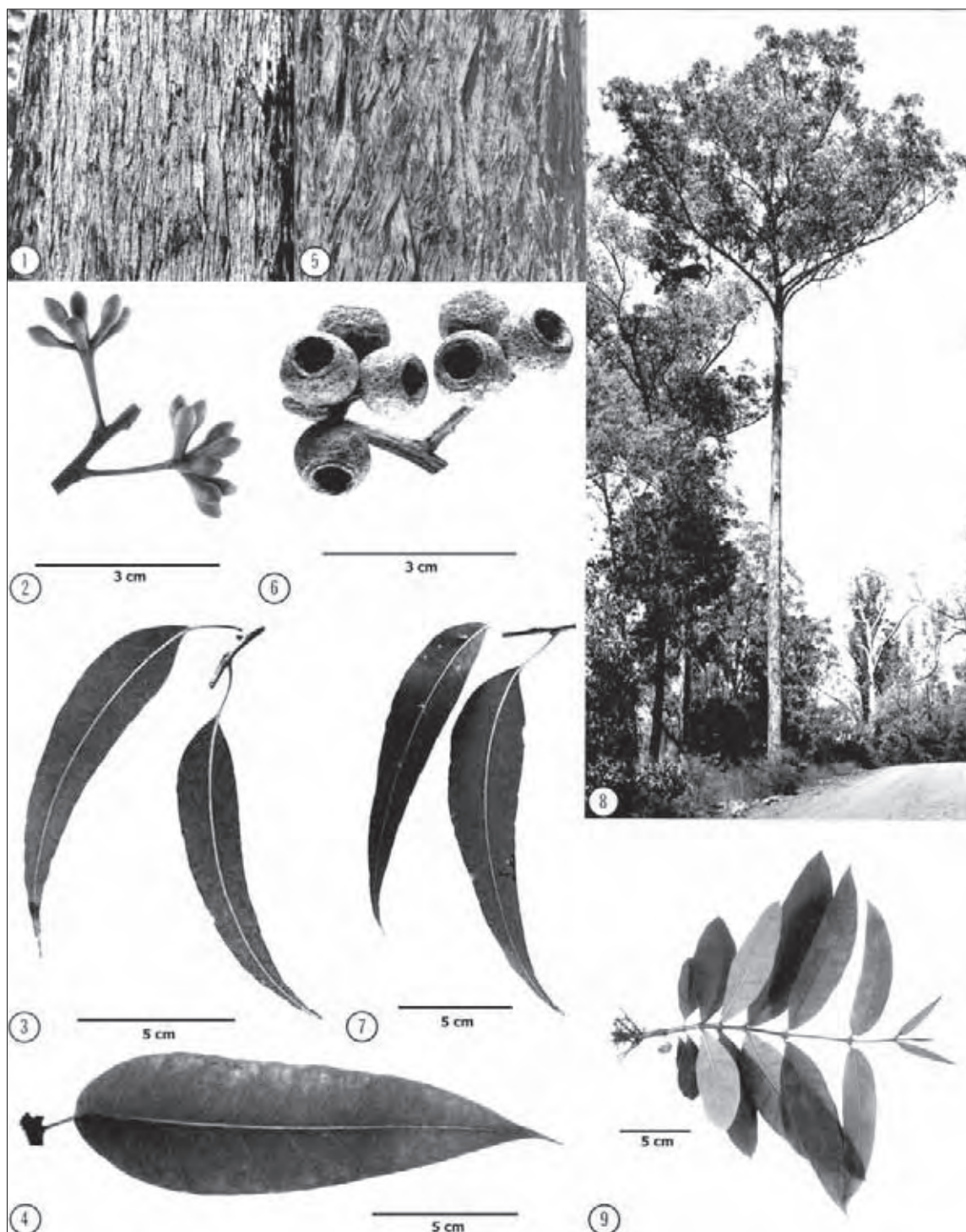
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles flattened, 0.8–1.2 cm long; pedicels 0.1–0.4 cm long; buds ovoid to broadly fusiform, $0.7\text{--}1 \times 0.4\text{--}0.5$ cm; opercula conical to almost hemispherical. Flowers Sept.–Feb.

Fruits: Pedicellate, truncate-globose, $0.9\text{--}1.1 \times 1\text{--}1.3$ cm; disc moderately broad, descending; valves mostly 3, enclosed. Seeds pyramidal or obliquely pyramidal, brown, hilum terminal.

Wood: Heartwood brownish, tough, strong, hard, heavy, durable, coarse-grained; density about 945 kg m^{-3} ; used for general building construction.

Climate: Altitudinal range: ± 600 m; Hottest/coldest months: $30^\circ\text{C}/5^\circ\text{C}$; Frost incidence: low; Rainfall: 1000 mm per year, summer max.

Distinctive features: Usually a large tree with a distinct light bluish tinge to the crown; firm, grey, fibrous, persistent bark; axillary, 7 to 11-flowered inflorescences with peduncles flattened, at least in the flowering stage; fruits truncate-globose; young seedlings with large pendulous juvenile leaves like those of the blue ash group.



Eucalyptus sphaerocarpa 1, 5. Bark 2. Buds 3. Adult leaves 4. Juvenile leaf 6. Fruits 7. Intermediate leaves 8. Tree, Blackdown Tableland, south-east of Blackwater, Qld 9. Seedling

Needlebark Stringybark Planchon's Stringybark, Bastard Tallowwood

Eucalyptus planchoniana F. Muell.

Needlebark stringybark occurs typically on poor sites and is consequently a small tree of rather poor form, to 20 m in height and less than 1 m dbh, but in better forests it may attain 30 m, though trees of this size are not common. On the poorest sites (e.g. Evans Head) it is reduced almost to mallee form and may be only 3–4 m high. The crown is usually small and rather open, but young trees on good sites have comparatively large and moderately dense crowns.

This species occurs in northern New South Wales and south-eastern Queensland, from near Camden Haven (about 160 km north of Newcastle) north to quite high elevations on the Gibraltar Range, and to Stradbroke and Moreton Islands east and north-east of Brisbane, also south of Brisbane and south-east of Brisbane.

Needlebark stringybark is mainly found on the low ridges and gentle slopes of coastal lowlands. The soils vary from light, poorly drained silts and clays to free-draining skeletal and poor infertile coastal sands.

It grows mostly in open forests or woodlands and rarely occurs in pure stands but may be the dominant species on some sites. Associated eucalypts include one of the scribbly gums (*E. racemosa*), red bloodwood (*E. gummifera*), some of the stringybarks and red gums and, occasionally, the poorer forms of blackbutt (*E. pilularis*). On sandy sites it often occurs with *Banksia* and *Xanthorrhoea* species.

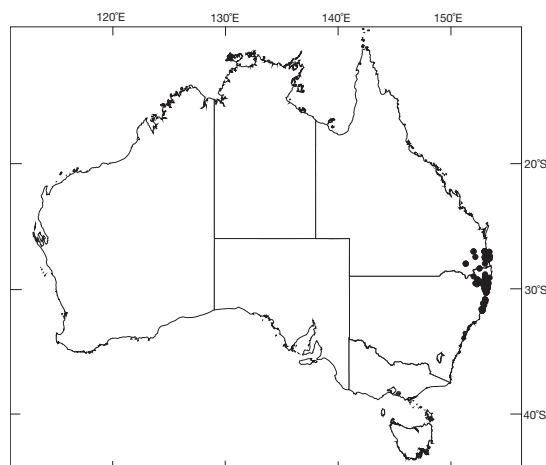
Related species: Brooker (2000) considered needlebark stringybark to clearly belong in subgenus *Eucalyptus* but not to be closely related to any other species. It was placed in its own section (*Insolitae*) as it shares the large, petiolate, pendulous juvenile leaves of the blue ash group of species, but the very large ribbed fruits distinguish it from any other eastern species. In the field, the bark could be confused with that of tallowwood (*E. microcorys*), but this species is quite unrelated and its crown readily distinguished by the green, discoloured adult leaves.

Publication: *Fragm.* 11, 43 (1878). Type: Eight Mile Plains, Moreton Bay, Queensland, ?1879, F.M. Bailey.

Names: Botanical—honours J.E. Planchon (1823–1888), a distinguished French medical scientist and botanist. Common—refers to the bark texture (though not a true stringybark).

Bark: Rough and persistent on the trunk and branches, short-fibred, moderately thick, spongy, with somewhat shallow longitudinal furrows, breaking easily into prickly fragments, dark red-brown, weathering to yellowish grey.

Leaves: Seedling—opposite and sessile for 3–5 pairs then becoming alternate and shortly petiolate, a few pairs more or less elliptical then ovate, with a sharply tapered tip, 7.5–17 × 3–7 cm, bluish green, slightly discoloured. Juvenile—alternate, petiolate, ovate to broad-lanceolate, with a sharply tapered tip, 11–20 × 5–10 cm, bluish green, becoming concolorous. Intermediate—alternate, petiolate, broad-lanceolate, often falcate, oblique, tapering to a long, fine point, 15–21 × 3–4.5



cm, bluish green, concolorous. Adult—alternate, petiolate, broad-lanceolate to lanceolate, often falcate and oblique, tapering to a long, fine point, 12–16 × 2–3.3 cm, bluish green, concolorous.

Inflorescences: Simple, axillary, 7-flowered; peduncles broad (to 1 cm wide), flattened, 1.3–3 cm long; pedicels angular, 0.2–1 cm long (not easily distinguished as they taper gradually into the hypanthium); buds elongated, cylindroid, ribbed, 2–3 × 0.7–0.9 cm; opercula conical. Flowers Dec.–Jan.

Fruits: Pedicellate, globose to ovoid, 1.7–2.6 × 1.5–2.6 cm, thick walled, woody, distinctly ribbed, disc broad, generally descending, occasionally level; valves 4, enclosed. Seeds pyramidal or obliquely pyramidal, dark brown, black or grey, hilum terminal.

Wood: Heartwood light to dark brown, sometimes with a greasy nature, hard, moderately heavy, durable; basic density 675–765 kg m⁻³; when available in suitable quality, this timber is similar to tallowwood (*E. microcorys*), but tends to be finer-textured, and sometimes known as bastard tallowwood, and is used for similar purposes.

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest months: 25–30°C/–2–10°C; Frost incidence: low to high (high elevation sites); Rainfall: 1000–1650 mm per year, summer max.

Distinctive features: Red-brown persistent, fibrous bark; seedlings like those of the blue ash group; large, falcate, bluish green adult leaves; large, elongated, ribbed buds; very large, ribbed fruits.



Eucalyptus planchoniana 1. Buds 2. Fruits 3. Seedling 4. Juvenile leaves 5. Bark 6. Adult leaf venation 7. Intermediate leaves 8. Tree, between Woolgoolga and Grafton, N.S.W. 9. Adult leaves

Black Sallee Black Sally

Eucalyptus stellulata Sieber ex DC.

Black sallee is a small tree 6–15 m tall and 30–60 cm in diameter at ground level, or more rarely a mallee. It is usually a poorly formed tree branching below or about half tree height to form a relatively dense crown of glossy green leaves.

This species occurs on tablelands, high country or subalpine regions in New South Wales, from north-east of Tenterfield, the Guyra–Ben Lomond plateau and near Ebor, south to eastern Victoria where it also occurs at lower altitudes in cold valleys, e.g. Rose and Buckland River valleys.

Black sallee is most common adjacent to creeks and flats in mountainous, tableland country. Typical locations experience difficult growing conditions for many plants, as they are usually frost hollows on soils that are poorly drained. Heavy snowfalls are also typical. Soils usually have heavy silt or clay near the surface and while poorly drained they are not continuously waterlogged. At Brumby Point in Victoria, the site is drier and the form of the species is reduced to that of a mallee. Soils are mainly derived from alluvia but in northern New South Wales the soils are often of basaltic origin.

Black sallee grows in open grassy woodlands. On very frosty sites that have poor drainage it may be the main species with snow gum (*E. pauciflora*) nearby. Less commonly associated species include swamp gums (*E. ovata*, *E. camphora*) and black gum (*E. aggregata*).

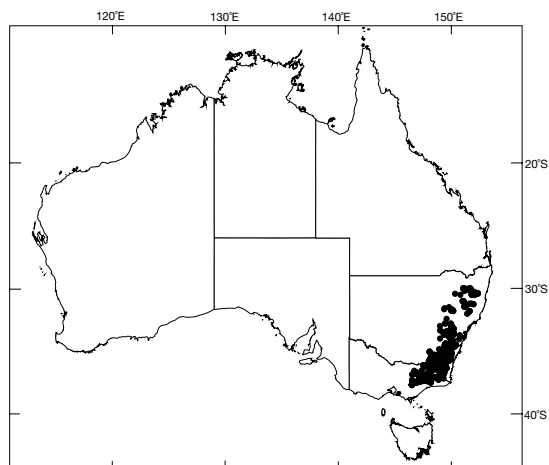
Related species: Brooker (2000) placed black sallee in a small group of three species (section *Longitudinales*), which should not be confused with any others. All are small trees or mallees of usually elevated sites. Because of the conspicuous longitudinal venation of the adult leaves, the group has been incorrectly associated taxonomically with snow gums, which belong to a different section (*Cineraceae*). The two groups differ markedly in the bud shape, sessile, crowded and fusiform in the *Longitudinales*, clavate and usually pedicellate and not clustered in the *Cineraceae*. Within the *Longitudinales*, black sallee differs from narrow-leaved sally (*E. moorei*) and Mount Buffalo gum (*E. mitchelliana*) in the dark grey to black rough basal bark. Smooth-barked mallee forms of black sallee are distinguished by the typical broad, juvenile leaves which are opposite for many pairs.

Publication: *Prodromus* 3, 217 (1828). Type: Port Jackson to the Blue Mountains, New South Wales, 1823, F.W. Sieber 478.

Names: Botanical—Latin *stellulatus* (star-shaped), referring to the bud clusters. Common—from the basal bark colour and the popular name ‘sallee’ (or ‘sally’) which is applied widely to the true snow gums even though *E. stellulata* is not related to them.

Bark: Rough at the base, compact, dark grey or black, smooth bark above yellow-green to olive-green; upper trunk and branches often with partly shed ribbons.

Leaves: Seedling—opposite for many pairs, sessile, cordate to almost orbicular, sometimes elliptic, 2.5–7 × 2–5 cm, dull, light green. Juvenile—opposite, sessile, orbicular to ovate,



4–10 × 3–5 cm, dull, green. Intermediate—alternate, petiolate, ovate to broadly ovate, 5–8 × 2.5–4 cm, firm texture, concolorous, venation distinct at 15–30° to the midrib. Adult—alternate, petiolate, elliptic to broad-lanceolate, uncinately, 5–11 × 0.9–3 cm, glossy, green, concolorous, venation more or less at 15° to the midrib or nearly parallel, minor nerves sparse or absent.

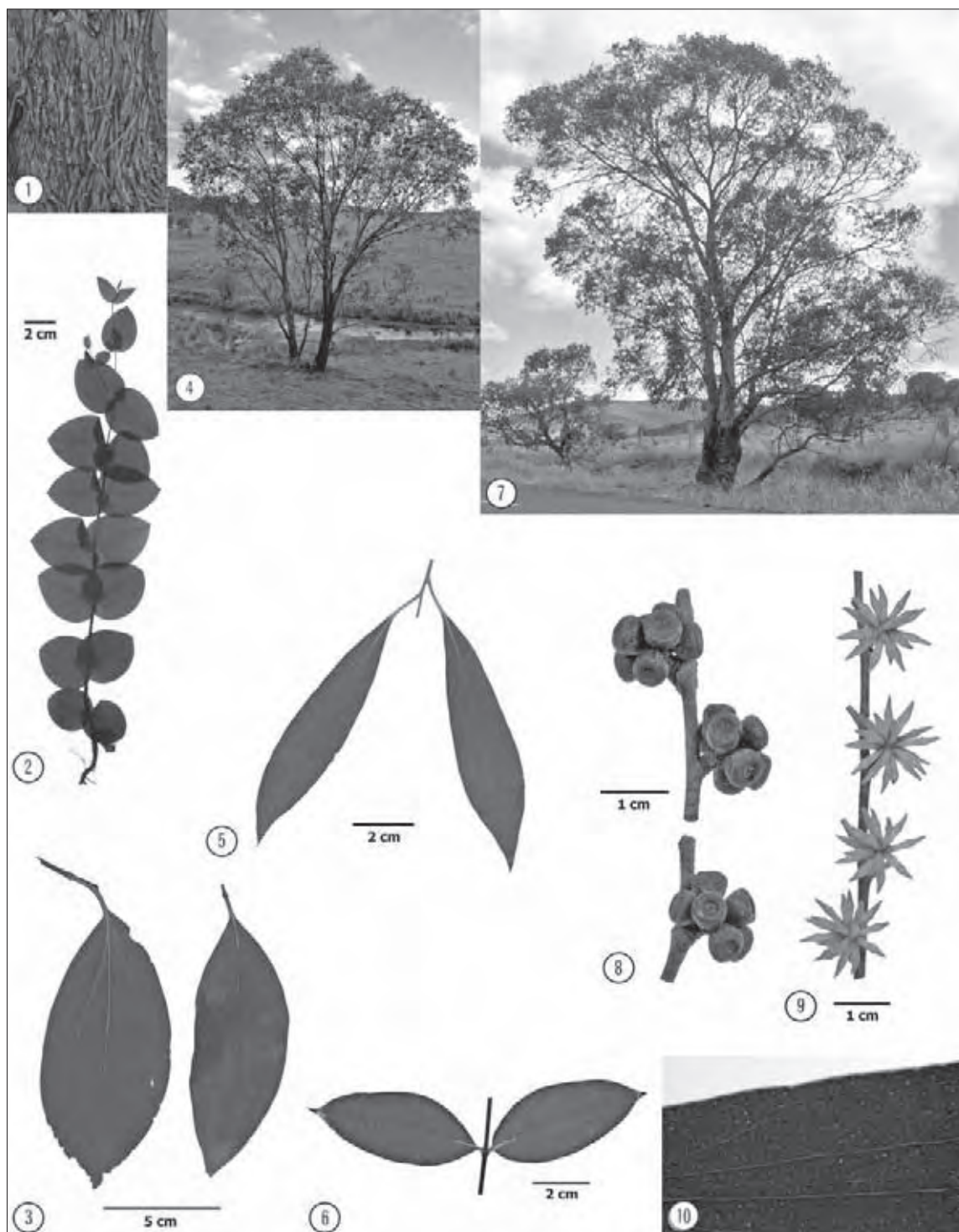
Inflorescences: Simple, axillary, in stellate clusters, 9 to 15-flowered; peduncles 0.1–0.6 cm long; buds sessile, fusiform, ca. 5 × 2.5 mm; opercula conical. Flowers Apr.–Oct.

Fruits: More or less sessile, crowded, cupular to truncate-globose, 0.3–0.5 × 0.3–0.5 cm; disc more or less level; valves 3, enclosed. Seeds pyramidal or obliquely pyramidal, brown or reddish brown, hilum terminal.

Wood: Pale, non-durable; has limited commercial value but is good firewood; used in the round and for temporary fencing.

Climate: Altitudinal range: 600–1500 m; Hottest/coldest months: 18–26°C/–5 to –3°C; Frost incidence: high (snowfalls common during winter); Rainfall: 630–1500 mm per year, uniform to summer max.

Distinctive features: Small tree, more rarely a mallee, with basal, compacted rough bark, smooth yellow-green or olive-green above, mallee form smooth-barked; seedling and juvenile leaves rounded, adult leaves glossy green with three prominent longitudinal veins; inflorescences axillary, in stellate clusters, buds sessile and fusiform; usually on poorly drained sites.



Eucalyptus stellulata 1. Bark 2. Seedling 3. Intermediate leaves 4, 7. Trees, near Hillgrove, N.S.W. 5. Adult leaves 6. Juvenile leaves 8. Fruits 9. Buds 10. Adult leaf venation

■ Ashes

Eucalyptus section *Eucalyptus* Brooker ('green' ashes) and section *Cineraceae* Brooker ('blue' ashes)

The ash group of eucalypts comprises about 35 species. It includes some of the most important timber trees of Australia, the tallest hardwood in the world, and several small trees and mallees.

The ashes are widespread in south-eastern Australia. They occur in a crescent from near Eungella in Queensland (*E. andrewsii*) to Kangaroo Island in South Australia (*E. remota* and *E. obliqua*). Several species occur in Tasmania but none on the Bass Strait islands. Messmate stringybark (*E. obliqua*) is the most widely distributed species, occurring in five States, while a few others are of notably restricted occurrence, e.g. Kangaroo Island mallee ash (*E. remota*), Jillaga ash (*E. stenostoma*) and cliff mallee ash (*E. cunninghamiana*).

The name 'ash' was applied in the early days of settlement because of a superficial resemblance of the timber to that of the unrelated European ash (*Fraxinus* species).

The timbers of the ashes are all pale coloured, of moderate weight and hardness, and have an open texture, straight grain and comparatively low durability. Some species, notably alpine ash (*E. delegatensis*), silvertop ash (*E. sieberi*) and sometimes mountain ash (*E. regnans*), develop conspicuous growth rings, a feature not common in *Eucalyptus*. The timbers are relatively strong, fissile and readily worked. Though showing a marked tendency to collapse during seasoning, they recondition readily. Extensive use of ash timber is made for house framing, flooring, weatherboards and joinery, as well as furniture and cabinetwork. Species of this group also supply a large part of the raw material for the pulp and paper industry, and the ashes supply most of the timber for the woodchip industry in south-eastern Australia.

The most important commercial ashes are mountain ash (*E. regnans*), messmate (*E. obliqua*), alpine ash (*E. delegatensis*) and silvertop

ash (*E. sieberi*). These eucalypts form the major constituents of most of the commercial forests of Tasmania and of southern and eastern Victoria and, with the exception of mountain ash, are of importance in parts of southern New South Wales. Ashes are typically species of cool, moist climates, and the taller members are limited to regions where the annual rainfall is at least 1000–1500 mm, distributed throughout the year so that there is no marked dry season. In these regions they tend to grow in pure stands or mixed with only a few species, and show best development on deep, loamy soils.

Some of the most attractive forests of Australia are those of mountain ash in the mountainous areas of Victoria and Tasmania.

Botany

The ashes are divided into two main groups (Brooker 2000), firstly the 'green ashes' (section *Eucalyptus*), best known by mountain ash (*E. regnans*) and messmate stringybark (*E. obliqua*) and also the Blue Mountains mallee ash (*E. stricta*), which are characterised by the glossy green juvenile leaves, and secondly the 'blue ashes' (section *Cineraceae*) which include silvertop ash (*E. sieberi*) and the 'snow gums' (*E. pauciflora*) which are characterised by the grey-green juvenile leaves.

Only a few pairs of seedling leaves in the ashes remain opposite and horizontally disposed. Then there is a distinctive change whereby the subsequent leaves are petiolate. The petioles twist and the juvenile leaves become vertically disposed (see Fig. 17a). They are broad, oblique, grey-green and distinctly pendulous in the 'blue ashes', and green and less prominently pendulous in the 'green ashes'. These features are readily seen in the field in areas of regrowth. The ash species are notable for their vigorous regeneration from seed but always require an abundance of daylight. Consequently they are only seen in large numbers in clearings or roadsides. The adult leaves are lanceolate or somewhat falcate with acute or parallel venation and sparse reticulation. Some mallee ashes, however, have linear adult leaves.

Within the ashes the species can be divided as well into two groups on seed colour. One group, which includes messmate (*E. obliqua*), has brown seeds while the other group, which includes alpine ash (*E. delegatensis*), has black seeds.

The ashes can be further divided into groups on staminal filament inflexion. One group including silvertop ash (*E. sieberi*) has buds with completely inflexed filaments (Fig. 24a). The group, which includes white ash (*E. fraxinoides*), has buds with flexuose filaments (Fig. 24b).

The proportion of persistent rough bark to smooth (deciduous) bark on a tree varies considerably between species. In the case of mountain ash, only a stocking of rough bark remains at the base of the long clean bole. At the other extreme, for example, in *E. obliqua* and in yertchuk (*E. considiniana*), rough bark is retained to the small branches. In brown barrel (*E. fastigata*), the fibrous bark persists to the large branches while the smaller ones are smooth. In mainland alpine ash (*E. delegatensis*), rough bark typically

remains only on the lower half of the bole, while in southern Tasmania it is retained much higher. The barks of messmate stringybark and brown barrel are brown, moderately thick and fibrous and somewhat resemble those of the stringybark group. With silvertop ash (*E. sieberi*), the bark is at first flaky and orange-brown, then becomes thicker, compacted and dark, and finally, in a mature tree, it is hard and deeply furrowed and resembles some of the ironbarks. Yertchuk and New England blackbutt (*E. andrewsii*) are unusual among the ashes in having a somewhat thin, finely fibrous bark like that of the peppermints. The smooth upper bark of most ashes, whether the whole trunk or that above a rough stocking, is often scribbly.

With experience in the field these important bark distinctions can be recognised. It is necessary, however, to assess the age of the tree, as bark form in the ashes can change markedly with age.



Mountain ash (*E. regnans*) is considered the world's tallest flowering plant. 1. Old trees can reach substantial girths as shown by a tree near Mt Erica, Victoria. 2. An even-aged stand with an understory dominated by tree ferns (*Dicksonia antarctica*) at Bulga National Park, Victoria (image: O Strewé).

Messmate

Messmate Stringybark

Eucalyptus obliqua L'Hér.

Messmate is a tall to very tall tree and in typical hilly or mountainous locations attains 45–90 m in height and 2–3 m dbh. The trunk is typically two-thirds or more of the tree height, and of good form. In some poor coastal sites it is reduced to a tall shrub.

Messmate is widely distributed in the cooler, southern parts of eastern Australia. In Victoria it is found throughout the central and southern parts of the State, but to a lesser extent north of the Great Dividing Range. It is a common species in Tasmania, where it occurs almost throughout the State but scattered on the west coast and parts of the central-eastern region. In New South Wales it occurs on the eastern side of the Southern and Northern Tablelands and extends into adjacent areas of Queensland to Mistake Range. Northern stands are disjunct, separated by the dry corridor of the Hunter River valley region. In South Australia it occurs in the Mount Lofty Ranges near Adelaide, on Kangaroo Island and in the south-east of the State.

This species occurs on hilly or mountainous country on a wide range of soils with best development on good quality loams. Rock substrates include rocks of sedimentary and volcanic origin, granite and limestone.

The best stands of messmate are found in cool mountain areas in tall open eucalypt forests. It is often associated with brown barrel (*E. fastigata*), shining gum (*E. nitens*), mountain grey gum (*E. cypellocarpa*), manna gum (*E. viminalis*), alpine ash (*E. delegatensis*), and in South Australia brown stringybark (*E. baxteri*) and pink gum (*E. fasciculosa*).

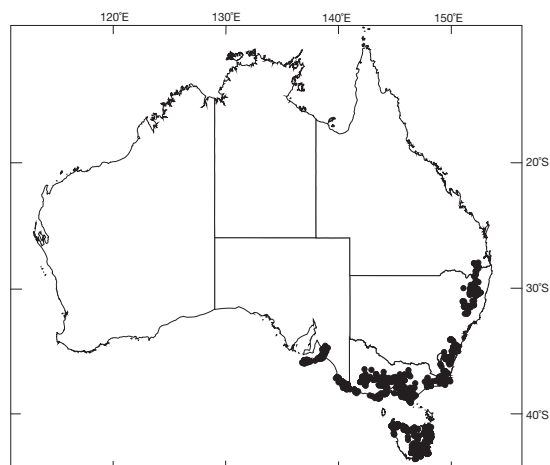
Related species: Brooker (2000) placed messmate in the 'green ashes group', section *Eucalyptus*, series *Eucalyptus*. It is easily distinguished from mountain ash (*E. regnans*) and brown barrel (*E. fastigata*) by the rough bark, which covers the whole trunk and the branches, and by its single inflorescences (not in pairs). Budawang ash (*E. dendromorpha*) can be readily distinguished in having rough bark only on its lower trunk, Pigeon House ash (*E. triflora*) by its 3-flowered inflorescences and *E. paliformis* is a small, mostly smooth barked tree with very small buds and fruits. The other 'green ashes' are all mallees and should not be confused with tree species.

Publication: Sert. Angl. 18 (1788). Type: Bruny Island, Tasmania, 1777, D. Nelson.

Names: Botanical—Latin *obliquus* (oblique), refers to the asymmetrical base of the leaves. Common—messmate is a word of uncertain origin applied to a number of rough-barked trees.

Bark: Rough and persistent to the small branches, thick, fairly dense, moderately long-fibred, rather stringy, deeply furrowed, with interlacing strands of fibres, grey over red-brown.

Leaves: Seedling—opposite for 3 or 4 pairs then alternate, sessile and amplexicaul for 2 or 3 pairs then shortly petiolate, ovate, 5–14 × 2.7–5 cm, dark green, glossy, discolorous. Juvenile—alternate, petiolate, ovate, becoming oblique, tapering suddenly to a pointed tip, 11–19 × 4–8 cm, dark



green, glossy, discolorous. Stems in the seedling and juvenile stages are covered with numerous raised oil glands.

Intermediate—alternate, petiolate, ovate to broad-lanceolate, oblique, 13–18 × 3.5–4.5 cm, dark green, glossy, slightly discolorous at first, becoming concolorous. Adult—alternate, petiolate, broad-lanceolate, oblique, or falcate, 10–13 × 1.5–3.3 cm, dark green, glossy, concolorous.

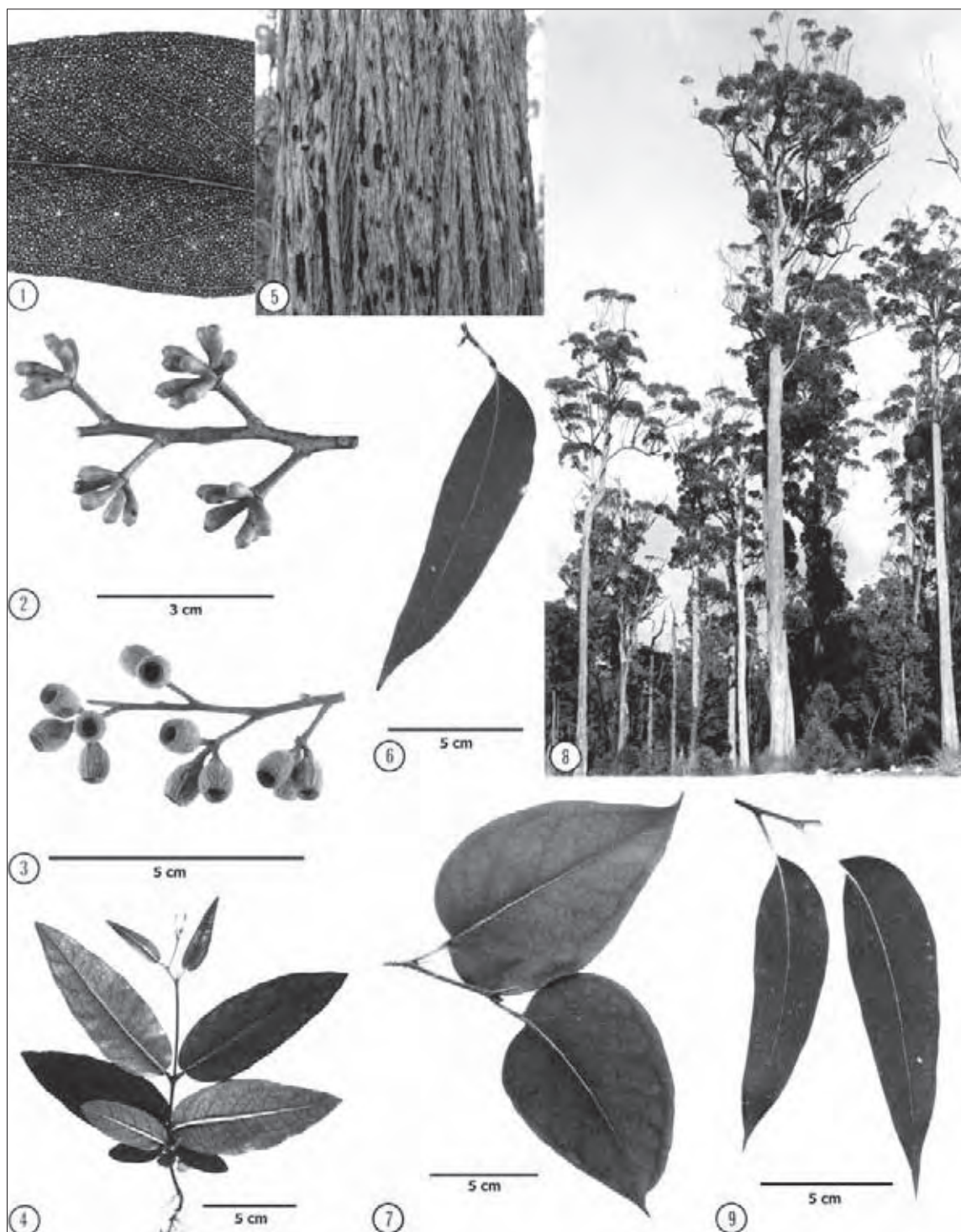
Inflorescences: Simple, axillary, 7–15 or more flowered; peduncles angular to flattened, 0.4–1.5 cm long; pedicels 0.1–0.6 cm long; buds clavate, 0.6–0.7 × 0.3–0.4 cm; opercula hemispherical–apiculate. Flowers Dec.–Mar.

Fruits: Pedicellate, ovoid, urceolate or truncate-globose, 0.6–1.1 × 0.5–0.9 cm; disc relatively broad, more or less level to steeply descending; valves 3 or 4, to rim level or enclosed. Seeds pyramidal or obliquely pyramidal, brown, hilum terminal.

Wood: Sapwood pale brown, susceptible to attack by *Lyctus* borers; heartwood light brown to brown, with open (coarse) texture, pores from old growth with white deposits, usually with straight grain and fairly well-defined annual rings, of moderate hardness and strength, relatively low durability, splits readily and is easily worked, glued and stained: density 540–840 kg m⁻³. One of the most important hardwoods of Australia; used for pulp production and for a wide range of purposes in construction and manufacture, including house building, joinery, flooring, furniture and interior finish. Wood structure is very similar to other ash group timbers including mountain ash (*E. regnans*) and alpine ash (*E. delegatensis*).

Climate: Altitudinal range: near sea level to 750 m; Hottest/coldest months: 19–29°C/–4–8°C; Frost incidence: low to high (up to more than 100 each year including snow at high elevations); Rainfall: 500–2400 mm per year, winter max. to uniform to summer max. in the north of its range.

Distinctive features: Bark fibrous and stringy, persistent to the small branches; juvenile to adult leaves with oblique bases, broad, glossy green; fruits generally ovoid, pedicellate, about 0.9 cm long, with broad, usually descending disc.



Eucalyptus obliqua 1. Adult leaf venation 2. Buds 3. Fruits 4. Seedling 5. Bark 6. Intermediate leaf 7. Juvenile leaves 8. Stand, near Smithton, Tas. 9. Adult leaves

Mountain Ash Swamp Gum (Tas.), Stringy Gum (northern Tas.)

Eucalyptus regnans F. Muell.

Mountain ash is one of the tallest tree species in the world, and is only exceeded in height by the redwoods of California. Under most conditions heights range from 55–75 m, but measurements up to 100 m have been recorded. While very large diameters do occur, typical measurements of large, mature trees are of the order of 2.5 m dbh. The trunk is straight, of excellent form and commonly two-thirds or more of the tree height, while the crown is open and relatively small.

Mountain ash occurs in Victoria and Tasmania. In Victoria it is mainly restricted to the mountains of the eastern half of the State, south of the Great Dividing Range, with small occurrences at Mt Macedon and in the Otway Ranges south-west of Melbourne. In Tasmania the occurrence is principally in the north-east, south-east and in the valleys of the Huon and Derwent Rivers.

Best development is found on sheltered aspects in mountainous country with rainfall greater than 1100 mm, on deep friable clay loam soils. Where soils are poorer and the rainfall lower, pure stands may be restricted to valleys and along watercourses. Rock substrates frequently include volcanics.

Mountain ash grows in tall open forests, mainly in pure stands. Associated species may be manna gum (*E. viminalis*), shining gum (*E. nitens*), myrtle beech (*Nothofagus cunninghamii*) and silver wattle (*Acacia dealbata*).

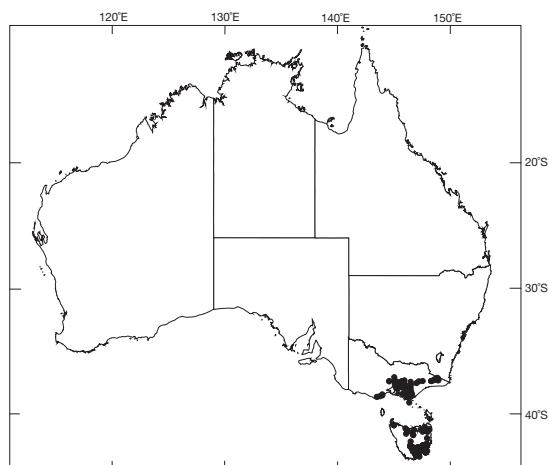
Related species: Brooker (2000) placed mountain ash, the tallest tree species in the 'green ashes group', in section *Eucalyptus*, series *Regnantes*, with its close relative *E. fastigata*. The two species share the very rare character in the genus of having paired inflorescences in the axils of the leaves. Brown barrel (*E. fastigata*) is distributed from the Northern Tablelands of New South Wales, through the high country to the south and just into Victoria and differs in the rough bark over the whole trunk and fruits with a slightly domed disc. Both species have conspicuous ribboning of partly shed bark in the crowns.

Publication: *Rep. Acclim. Soc. Victoria* 20 (1870). Type: Dandenong Ranges, Victoria, Mar. 1867, D. Boyle.

Names: Botanical—Latin *regnans* (ruling), of its height and dominance. Common—refers to habitat and the similarity of the timber to the ash (*Fraxinus*) of the northern hemisphere.

Bark: Rough and persistent, fibrous at the base for up to 15 m, the remainder smooth, white or greenish grey, thin, shed in long ribbons, often conspicuously hanging from the branches.

Leaves: Seedling—opposite for 2 or 3 pairs then alternate, petiolate, ovate, 5–13 × 2.5–4.5 cm, green, discolorous. Juvenile—alternate, petiolate, ovate, oblique, tapering suddenly to a pointed tip, 11–17 × 4.5–8 cm, green, discolorous at first, soon becoming concolorous. Stems at seedling and juvenile stages have numerous raised oil glands. Intermediate—alternate, petiolate, broad-lanceolate, oblique, 13–21 × 3.5–6 cm, green, glossy, concolorous. Adult—



alternate, petiolate, broad-lanceolate to lanceolate, 9–14 × 1.6–2.7 cm, glossy green, concolorous.

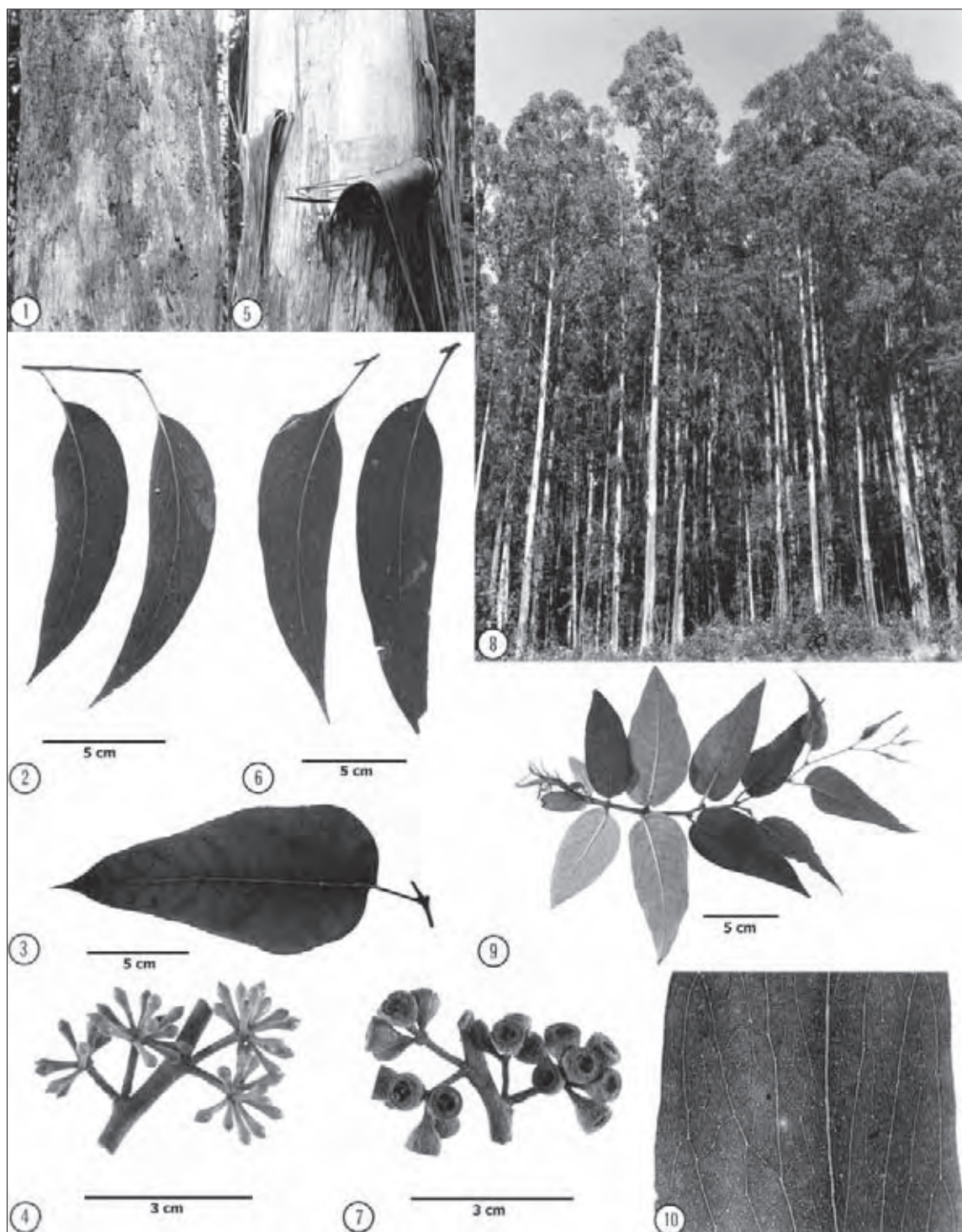
Inflorescences: Simple, axillary, usually paired, 9 to 15-flowered; peduncles angular, 0.5–1.3 cm long; pedicels 0.2–0.4 cm long; buds clavate, 0.5–0.7 × 0.3–0.4 cm; opercula hemispherical-apiculate or conical. Flowers Dec.–May.

Fruits: Pedicellate, obconical to hemispherical, 0.5–0.9 × 0.4–0.7 cm; disc relatively broad, more or less level; valves 3, to rim level or slightly enclosed, occasionally very slightly exerted. Seeds pyramidal or obliquely pyramidal, brown, hilum terminal.

Wood: Sapwood indistinct, to 2.5 cm wide, resistant to *Lyctus* borer attack; heartwood pale brown with open (coarse) texture, straight grain, first 5–6 growth rings from the pith are prominent and the rest are variable in distinctiveness, moderately strong and hard but not durable, easily split and worked, dresses and finishes well; density about 600–800 kg m⁻³; used for engineering and building construction, marine craft, flooring, architraves, furniture, plywood; in the past, trees harvested from natural stands were considered one of the best of the eucalypts for the Australian pulp and paper industry. For more information on distinguishing between mountain ash and woods of similar appearance, see Illic (1997).

Climate: Altitudinal range: 150–1100 m (Vic.), near sea level to 600 m (Tas.); Hottest/coldest months: 22–25°C/–2–4°C; Frost incidence: low to high (80 or more each year with snow at high elevations); Rainfall: 750–1700 mm per year, winter max.

Distinctive features: Usually a very tall tree; non-lignotuberous, with a stocking of fibrous bark then smooth, white or grey above, often ribbony; inflorescences axillary, in pairs, a characteristic only regularly shared in the monocalypts with brown barrel (*E. fastigata*).



Eucalyptus regnans 1, 5. Bark 2. Adult leaves 3. Juvenile leaf 4. Buds 6. Intermediate leaves 7. Fruits 8. Stand, Mt Erica area, north of Yallourn, Vic. 9. Seedling 10. Adult leaf venation

Brown Barrel Cut-tail

Eucalyptus fastigata Deane & Maiden

Brown barrel is a tall to very tall tree, usually 30–45 m in height and 1–2 m dbh. In the best sites heights of 60 m are attained. The trunk is from half to two-thirds of the tree height, while the crown is relatively large and evenly distributed and usually has conspicuous hanging ribbons of bark. Open growing specimens are prominently branched over most of the trunk. Old, persistent branch stubs on the trunks are characteristic of the species.

The main occurrence of brown barrel is in the Southern Highlands and adjacent coastal escarpments of New South Wales. It extends into Victoria south-east of Bendoc on the Errinundra Plateau and Wog Wog Mountain. Outliers to the north of its main distribution include Point Lookout and Barren Mountain near Ebor and the Barrington Tops and Murrurundi regions.

Brown barrel occurs in valleys and on the slopes of mountains and on the edges of tablelands, while in the warmer part of the range it prefers southern and eastern aspects, where insolation is not as great. Best development is on better soils, especially those of a loamy type with a moist, but well-drained subsoil. Sandstone, granite, quartzite and occasionally basalt are the most common rock substrates.

Under very favourable conditions brown barrel occurs in tall open forests. It is found in pure stands over limited areas, but more commonly it grows in association with other eucalypts such as alpine ash (*E. delegatensis*), mountain gum (*E. dalrympleana*), manna gum (*E. viminalis*), shining gum (*E. nitens*), messmate (*E. obliqua*), white ash (*E. fraxinoides*), narrow-leaved peppermint (*E. radiata* subsp. *robertsonii*) and broad-leaved peppermint (*E. dives*).

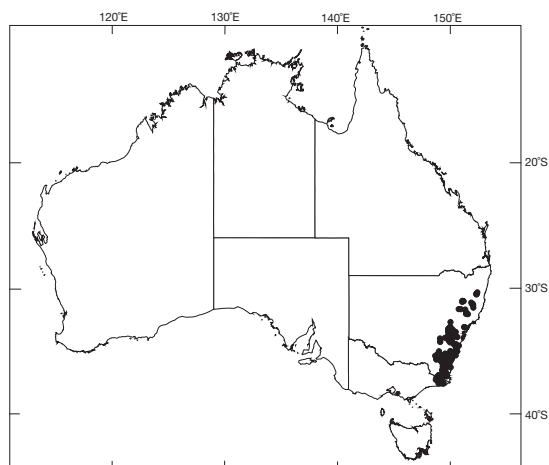
Related species: Brooker (2000) placed brown barrel, one of the tall tree species in the 'green ashes group', in section *Eucalyptus*, series *Regnantes* with its close relative *E. regnans*. The two species share the very rare character in the genus of having paired inflorescences in the axils of the leaves. Brown barrel is distributed from the Northern Tablelands of New South Wales through the high country of to the south and just into Victoria and differs in the rough bark over the whole trunk and fruits with a slightly domed disc. Both species have conspicuous ribboning of partly shed bark in the crown.

Publication: *Proc. Linn. Soc. N.S.W.* 21, 809 (1896). Type: Tantawango Mountain, New South Wales, Dec. 1896, H. Deane and J.H. Maiden.

Names: Botanical—Latin *fastigatus* (high, exalted), refers to the form of the best specimens. Common—refers to the colour of the bark.

Bark: Rough and persistent over the trunk and larger branches, brown, fibrous and tending to be stringy, sometimes conspicuously furrowed, decorticating above in long ribbons which hang in the canopy leaving smooth, white upper limbs.

Leaves: Seedling—opposite for 3 or 4 pairs then alternate, petiolate, ovate, 6–11 × 2.5–5.5 cm, green, discolorous. Juvenile—alternate, petiolate, ovate, oblique, 8.5–17 ×



3.5–5 cm, green, discolorous, held more or less horizontally. Intermediate—alternate, petiolate, broad-lanceolate, usually oblique, 14–19 × 3.3–5.5 cm, green, slightly discolorous to concolorous. Adult—alternate, petiolate, lanceolate, usually oblique, 8–15 × 1.5–2.7 cm, glossy green, concolorous or occasionally slightly discolorous.

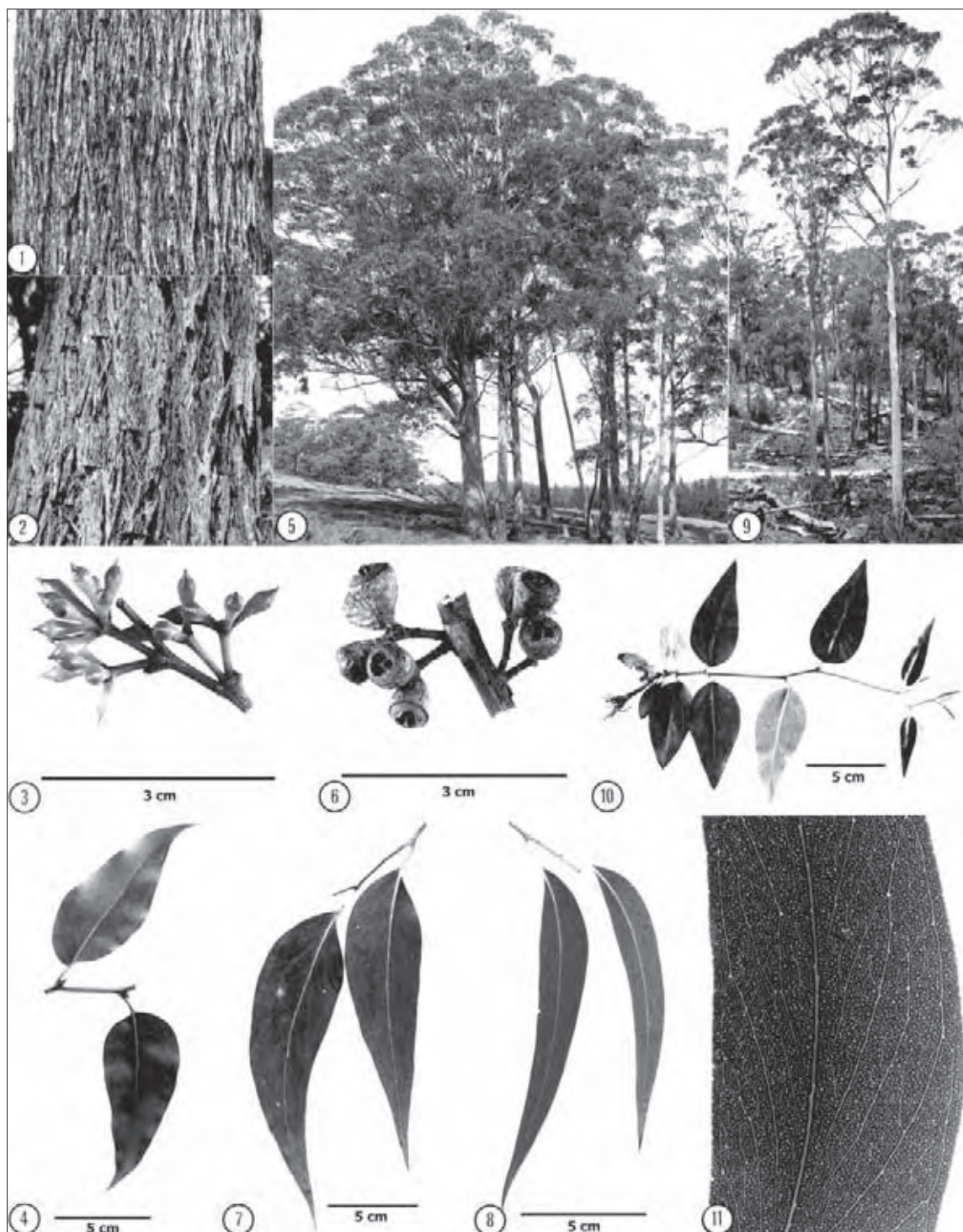
Inflorescences: Simple, axillary, usually paired, 11 to 15-flowered; peduncles terete to angular, 0.4–1.4 cm long; pedicels 0.1–0.2 cm long; buds clavate, 0.5–0.6 × 0.3 cm; opercula rostrate or hemispherical-apiculate. Flowers Dec.–Feb.

Fruits: Shortly pedicellate, pyriform, hemispherical or obconical, 0.5–0.8 × 0.4–0.7 cm; disc relatively broad, slightly ascending (domed); valves 3, about rim level or very slightly exerted. Seeds pyramidal or obliquely pyramidal, brown, hilum terminal.

Wood: Sapwood narrow, not easily distinguishable, susceptible to attack by *Lyctus* borers; heartwood light brown, straight-grained, open-textured, moderately hard, of moderate strength and durability, easily worked; density 610–815 kg m⁻³; the timber is comparable to that of mountain ash (*E. regnans*) but with fewer distinct growth rings and is used for many of the same purposes, especially building construction.

Climate: Altitudinal range: (300–)650–1400 m; Hottest/coldest months: 23–28°C/–2–3°C; Frost incidence: moderate to high (50–100 each year with snow at high elevations); Rainfall: 750–2000 mm per year, uniform to summer max.

Distinctive features: Tall to very tall non-lignotuberous tree with fibrous, furrowed bark, persistent on trunk and large branches, decorticating from the smaller branches in long ribbons which hang in the canopy; inflorescences mostly in pairs, a characteristic only shared in monocalypts with *E. regnans*.



Eucalyptus fastigata 1, 2. Bark 3. Buds 4. Juvenile leaves 5. Stand, between Black Springs and Taralga, N.S.W. 6. Fruits 7. Intermediate leaves 8. Adult leaves 9. Tree, Brown Mountain, between Nimmitabel and Bega, N.S.W. 10. Seedling 11. Adult leaf venation

Pigeon House Ash Three-flowered Ash

Eucalyptus triflora (Maiden) Blakely

Pigeon House ash is a small tree to 12 m tall and 20–40 cm in diameter, but may occasionally attain 15 m in height. It is usually erect, branching at above half-tree height to form a relatively thin crown of glossy green leaves.

Pigeon House ash has a restricted natural occurrence and is distributed sporadically in south-eastern New South Wales, from east of Nerriga in the upper Endrick River catchment, south to Pigeon House (mountain) and to Hanging Mountain west of Bodalla.

Pigeon House ash is confined to sandstone plateaux, along broad ridge tops or, less commonly, near the top of mountains. It usually occurs on massive outcrops of Permian sandstone where it grows among boulders. The soils are rather poor, sandy and free draining.

This is not a common species and grows in woodlands, either in small groups of a few trees or as scattered specimens with other eucalypts on sites that are too poor to support large trees. Associated eucalypts include silvertop ash (*E. sieberi*) and blue-leaved stringybark (*E. agglomerata*).

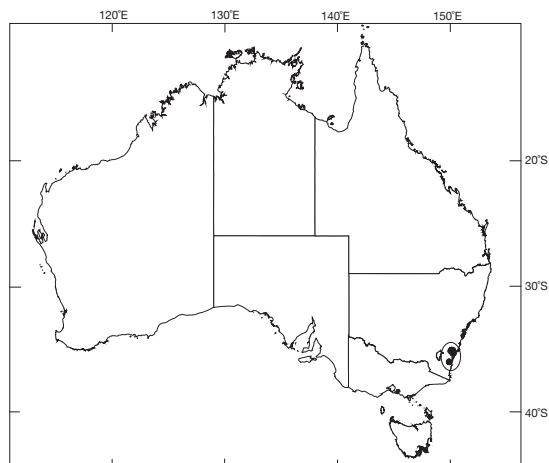
Related species: Brooker (2000) placed Pigeon House ash, which belongs to the ‘green ashes group’, in section *Eucalyptus* and the large, mallee dominated series *Strictae*. The series divides into two subseries diagnosed by the appearance of the leaf oil glands. Pigeon House ash is related to five other ashes (subseries *Irregulares*) in which the oil glands are irregular in outline, as seen in fresh leaves with transmitted light. The best known of these species is Blue Mountains mallee ash (*E. stricta*), one of four species of mallee ash which have 7-budded inflorescences and belong in a group, each differing by the adult leaf width. Pigeon House ash is one of two tree species in the subseries and is the only species of the series with predominantly 3-budded inflorescences. This character distinguishes it from the other tree species Budawang ash (*E. dendromorpha*), which is also a much taller tree at sites such as Mt. Budawang, a mountain within the distribution of Pigeon House ash.

Publication: *Key Eucalypts* 201 (1934). Type: Pigeon House Mountain near Milton, New South Wales, December 1899, R. H. Cambage.

Names: Botanical—Latin *tri* (three), *flora* (flowered) referring to the predominant bud number in the inflorescences. Common—refers to the location where it was first collected and the similarity of the timber to the ash (*Fraxinus*) of the northern hemisphere.

Bark: Compact or subfibrous at the base to 2 m, with imperfectly decorticated ribbons above, smooth white, grey or yellowish on upper trunk, usually with insect scribbles.

Leaves: Seedling—opposite for 4 or 5 pairs, sessile, then alternate and shortly petiolate, ovate-lanceolate, 2.5×1 cm, then broad-lanceolate to obovate, $5\text{--}11 \times 2.5\text{--}3.5$ cm, discolorous with a purplish shade on the undersurface. Juvenile—subopposite, shortly petiolate, ovate to oblong-lanceolate, $7.5\text{--}18 \times 3.8\text{--}8.5$ cm, thick, leathery, discolorous. Intermediate—shortly stalked, lanceolate, $4\text{--}11 \times 2.5\text{--}5.5$ cm leathery, slightly discolorous to concolorous. Adult—alternate,



shortly petiolate, lanceolate, more or less falcate and with an oblique base, $7\text{--}16 \times 0.8\text{--}2.5$ cm, glossy, green, concolorous.

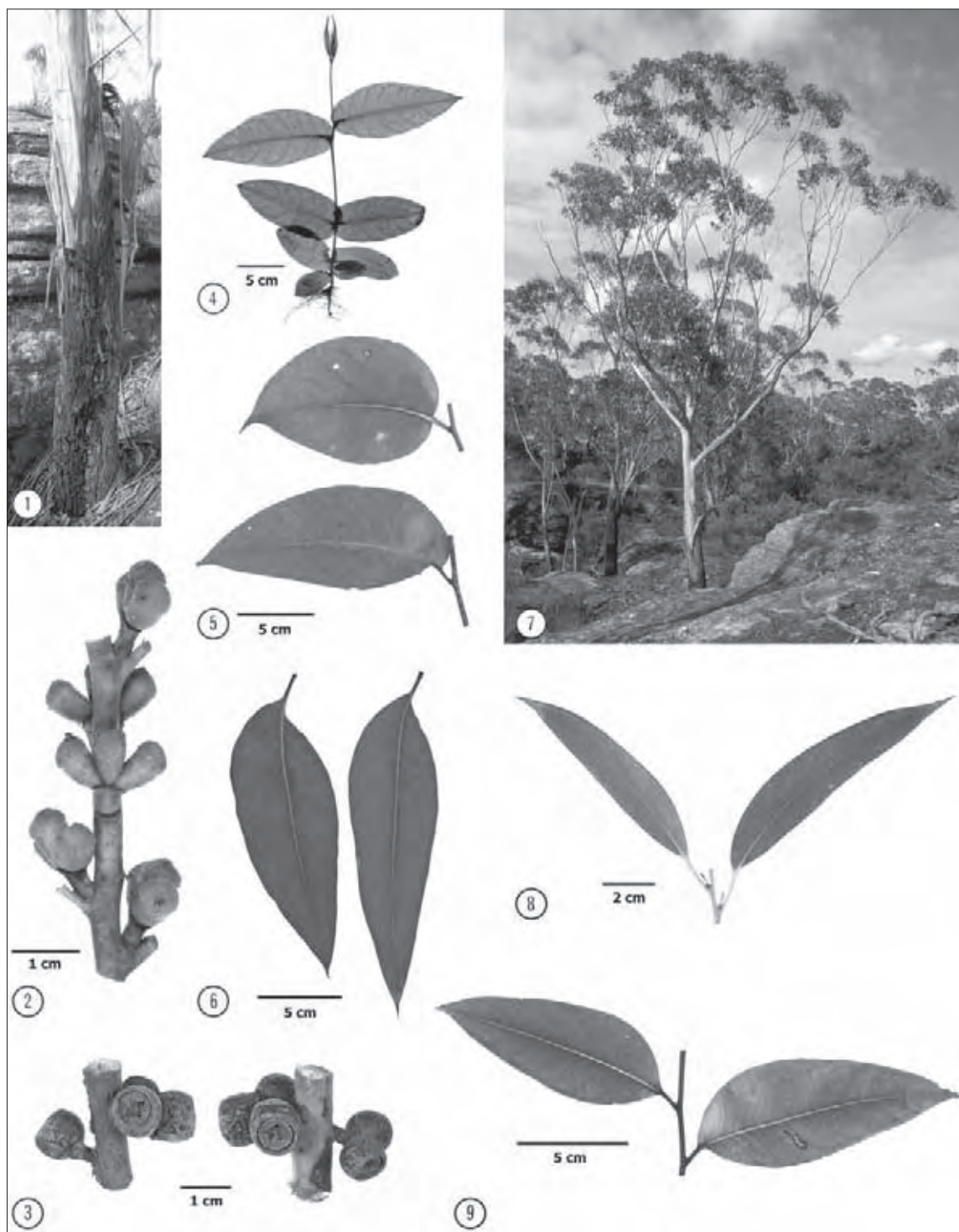
Inflorescences: Simple, axillary, 3(7)-flowered; peduncles very short, stout, flattened, $0.3\text{--}0.5$ cm long; buds sessile, cylindrical with some compression angles, to 0.7×0.5 cm; opercula flattened, hemispherical or broadly conical. Flowers Feb.–Mar.

Fruits: Sessile, cupular to almost hemispherical or slightly urceolate, $0.7\text{--}1 \times 0.7\text{--}1.2$ cm; disc level to descending; valves 4(5), enclosed. Seeds pyramidal or obliquely pyramidal, brown, hilum terminal.

Wood: Heartwood pale-coloured; other properties not known as it is rarely utilised.

Climate: Altitudinal range: 600–850 m; Hottest/coldest months: $23\text{--}24^\circ\text{C}/1\text{--}2^\circ\text{C}$; Frost incidence: moderate; Rainfall: 880–1250 mm per year, uniform.

Distinctive features: Small to medium-sized non-lignotuberous tree with basal rough bark, smooth above with scribbles; seedling and juvenile leaves glossy green, adult leaves glossy green; inflorescences axillary, peduncles very stout, predominantly 3-budded.



Eucalyptus triflora 1. Bark 2. Buds 3. Fruits 4. Seedling 5. Juvenile leaves 6, 9. Intermediate leaves 7. Tree, near Sassafras, N.S.W. 8. Adult leaves

Budawang Ash

Eucalyptus dendromorpha (Blakely) L.A.S. Johnson & D.F. Blaxell

Budawang ash is typically a tree 10–15 m tall on poorer sites but under favourable conditions attains 30–35 m with a dbh of 60–90 cm. On poor, rocky sites it is a straggly tree branching low, while on deeper soils it is an erect tree branching above three-quarter tree height to form a relatively small, thin crown of glossy green leaves. Tallest trees are found in the south of its distribution.

Budawang ash is endemic to New South Wales where it has a relatively limited distribution. It extends from the tablelands and slopes of the Blue Mountains west of Sydney, south to Budawang south-east of Braidwood. Where it occurs it is usually locally common. Budawang ash occurs on Mt Budawang, Mt Currockbilly and on Clyde Mountain. It also occurs on the Illawarra escarpment west of Wollongong, Fitzroy Falls, Barren Grounds and near Wentworth Falls. Budawang ash may intergrade with *E. triflora* and *E. burgessiana* in the northern parts of the Budawang Range.

This species commonly occurs on moist sandy soils, of low to medium fertility, derived from sandstone.

It grows in open forests and woodlands in association with silvertop ash (*E. sieberi*), red bloodwood (*E. gummifera*), Blue Mountains mallee (*E. stricta*), gully gum (*E. smithii*), Pigeon House ash (*E. triflora*), Port Jackson mallee (*E. burgessiana*) and Baeuerlen's gum (*E. baeuerlenii*).

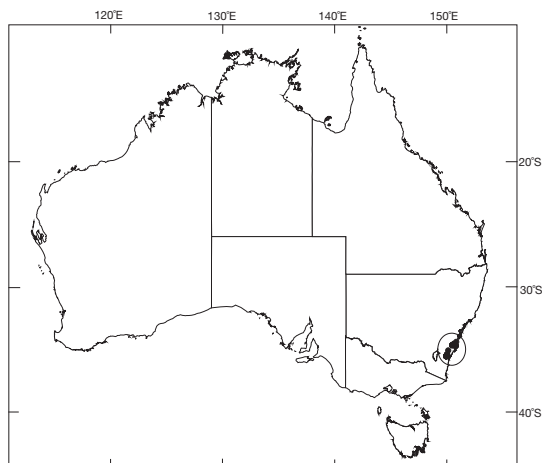
Related species: Brooker (2000) placed Budawang ash, which belongs to the 'green ashes group', in section *Eucalyptus* and the large, mallee dominated series *Strictae*. The series divides into two subseries diagnosed by the appearance of the leaf oil glands. Budawang ash is related to five other ashes (subseries *Irregulares*) in which the oil glands are irregular in outline, as seen in fresh leaves with transmitted light. The best known of these species is Blue Mountains mallee ash (*E. stricta*), one of four species of mallee ash which have 7-budded inflorescences and belong in a group, each differing by the adult leaf width. Budawang ash is one of the two tree species in the subseries, Pigeon House ash (*E. triflora*) being distinguished by the predominantly 3-budded inflorescences, while Budawang ash is 7–11 budded. The two species overlap in distribution, but Pigeon House ash never reaches the height of Budawang ash as seen on Mt. Budawang.

Publication: As *E. obtusiflora* var. *dendromorpha* Blakely in *Austral. Naturalist* 10, 258 (1941); as *E. dendromorpha* in *Contr. N. S. W. Natl Herb.* 4, 286 (1972). Type: West Albion Park, near Macquarie Pass, New South Wales, Jun. 1901, R.H. Cambage.

Names: Botanical—Greek *dendro* (tree), *morpha* (form) referring to the habit compared with most related green-leaved ashes. Common—from the mountain where it forms an impressive tall stand, and the similarity of the timber to the ash (*Fraxinus*) of the northern hemisphere.

Bark: Rough at the base, compact, or flaky or scaly, decorticate above in ribbons, smooth bark greyish white or greenish, usually with insect 'scribbles'.

Leaves: Seedling—first 3–5 pairs opposite, sessile or very shortly petiolate, broad-lanceolate, 8–12 × 3–4 cm; shiny



green, markedly discolorous. Stems rough due to numerous raised oil glands. Juvenile—alternate, petioles broad, flattened and 0.6–1 cm long; oblique, broad-lanceolate 11–12 × 4–5 cm; green, discolorous. Intermediate—alternate, petioles flattened, 1–1.4 cm long; oblique, broad-lanceolate, 11–13 × 3–3.5 cm; green, slightly discolorous. Adult—alternate, petioles slightly flattened, 1–1.3 cm long; lanceolate but usually falcate, 8–11 × 1.5–2 cm; green, concolorous. Leaves contain numerous oil glands.

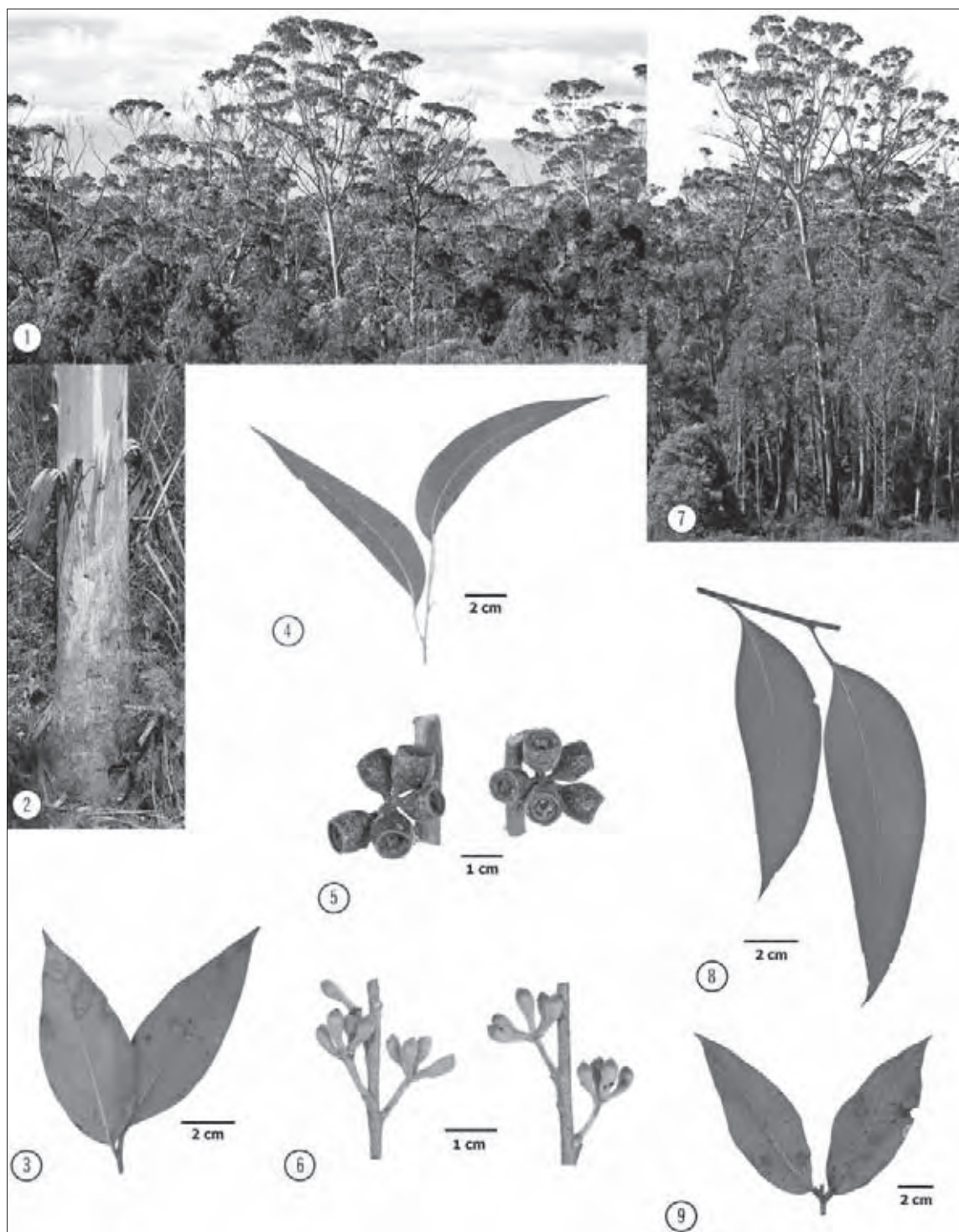
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles angular to flattened, 0.5–1 cm long; pedicels stout, terete, 0.2–0.4 cm long; buds clavate, often warty, 0.5–1 × 0.4 cm, opercula conical, 0.1–0.3 cm long. Flowers Jul.–Sep.

Fruits: Pedicellate, truncate-globose to slightly urceolate, 0.8–1.1 × 0.8–1.1 cm; peduncles stout, terete to flattened, 0.6–1.5 cm long; disc varies from near vertically depressed to horizontal, 0.1–0.2 cm wide; valves (3)4, enclosed. Seeds pyramidal or obliquely pyramidal, brown, hilum terminal.

Wood: Similar to other ash eucalypts; heartwood is light yellow-brown and tyloses are sparse, growth rings well-developed, density 600 kg m⁻³.

Climate: Altitudinal range: 550–1140 m; Hottest/coldest months: 26–27°C/0–5°C; Frost incidence: moderate to high; Rainfall: 1000–1700 mm per year, uniform.

Distinctive features: Small to medium-sized or tall non-lignotuberos tree depending on the site, with basal rough bark, smooth above with 'scribbles'; seedling and juvenile leaves glossy green, adult leaves glossy green; inflorescences axillary, 7 to 11-budded, buds usually warty.



Eucalyptus dendromorpha 1, 7. Trees, near Mt. Budawang, N.S.W. 2. Bark 3, 9. Juvenile leaves
 4. Adult leaves 5. Fruits 6. Buds 8. Intermediate leaves

Snow Gum Cabbage Gum (Tas.), Weeping Gum (Tas.), White Sallee

Eucalyptus pauciflora Sieber ex Sprengel and *E. lacrimans* L.A.S. Johnson & K.D. Hill

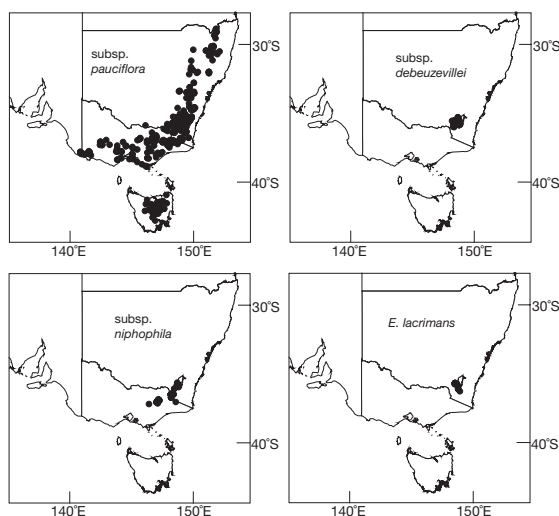
Snow gums are usually only 10–20 m in height with a short, crooked bole, which is commonly strongly branched from near ground level. For its size the bole may be stout and to 1 m dbh. Only rarely is the tree found up to 30 m in height, with a relatively straight bole. At high altitudes it is commonly a bushy shrub or low, twisted, wind-sculptured tree. There are three subspecies, the typical, subsp. *debeuzevillei* and subsp. *niphophila* and a closely allied, pendulous variant (*E. lacrimans*).

Snow gums have a wide distribution particularly in the mountains and tablelands of New South Wales, Victoria and Tasmania. In a few places they are found almost to sea level, as in parts of Tasmania, the Bega–Wolumla area of southern New South Wales, the Mornington Peninsula in Victoria and near Mt Gambier in South Australia. There is a small stand just north of the New South Wales border in south-eastern Queensland. Subsp. *pauciflora* which has the widest distribution and occurs to an altitude of about 1500 m; subsp. *niphophila* which is confined to the highest peaks as far as the treeline, at about 2000 m above sea level in south-eastern New South Wales and eastern Victoria; subsp. *debeuzevillei* which occurs at the highest elevations in the Kiandra, Brindabella and Jounama Range area of New South Wales. *E. lacrimans* occurs in the Adaminaby area of southern New South Wales.

Snow gums occur in many habitats, mountain slopes, exposed ridge tops and tablelands, as well as plains at lower altitudes. They are commonly found on shallow rocky soils as well as moderate quality, well-drained alluvial soils.

Snow gums occur mostly in open forests or woodlands, although at the highest altitudes they are found in tall shrublands. Associated eucalypt species include black sallee (*E. stellulata*), alpine ash (*E. delegatensis*), mountain gum (*E. dalrympleana*), manna gum (*E. viminalis*) and candlebark (*E. rubida*). In Tasmania snow gums may be found with manna gum, mountain gum, cider gum (*E. gunnii*), black peppermint (*E. amygdalina*) and swamp gum (*E. ovata*).

Related species: Brooker (2000) placed the snow gums, some of the smaller tree species in the ‘blue ashes group’, in section *Cineraceae*. They belong in the series *Pauciflorae* which is distinguished by the smooth bark and the completely fertile anthers, in contrast to related species which are either rough-barked (e.g. *E. sieberi*) or have some infertile stamens (e.g. *E. racemosa*). The snow gums have distinctive leaf venation in that the side veins run almost parallel to the midrib. This character is rarely seen outside of the snow gums, but some peppermint species approach it. Wolgan snow gum (*E. gregsoniana*) is easily distinguished as it has a mallee habit. Two snow gum variants with restricted distributions recognised by Rule (1994) have not been treated here. These are subsp. *acerina*, which occurs on the Baw Baw plateau and is a highly glossy-leaved form of subsp. *pauciflora*; and subsp.



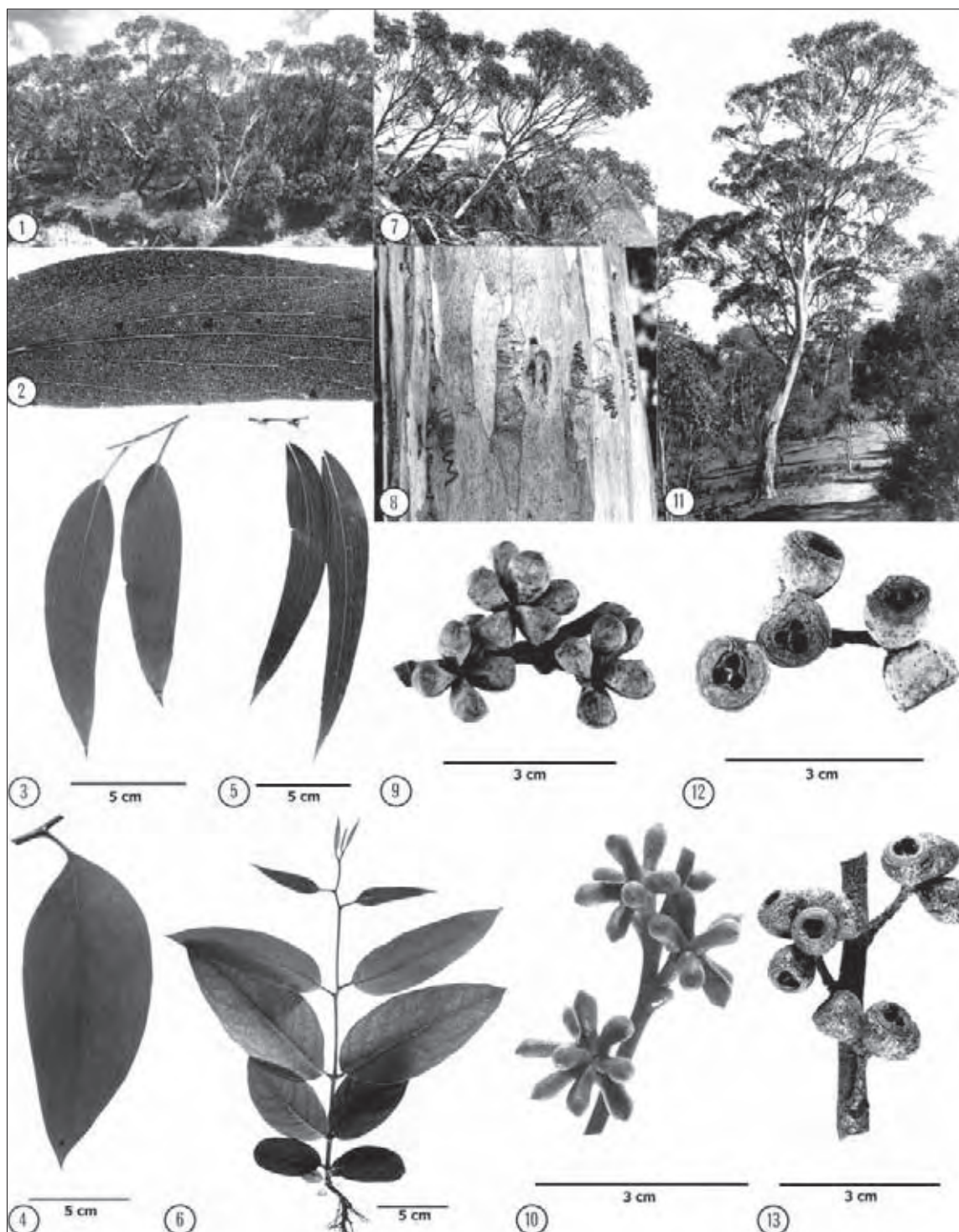
hedraia which is restricted to the Falls Creek area in Victoria and has relatively large, sessile buds and fruit.

Publication: *E. pauciflora*, *Syst. Veg. Cur. Post.* 4, 195 (1827). Type: Australia, 1823, F. W. Sieber 470. Subsp. *niphophila* (Maiden & Blakely) L.A.S. Johnson & D.F. Blaxell: *Contr. N.S.W. Natl Herb.* 4, 379 (1973). Type: Pretty Point, Mt Kosciusko, New South Wales, Jan. 1899, J. H. Maiden and W. Forsyth. Subsp. *debeuzevillei* (Maiden) L.A.S. Johnson & D.F. Blaxell: *Contr. N.S.W. Natl Herb.* 4, 379 (1973). Type: Jounama Peaks, New South Wales, Dec. 1919, W. A.W. de Beuzeville. *E. lacrimans* L.A.S. Johnson & K.D. Hill: *Telopea* 4, 264 (1991). Type: 12.6 km N of Rules Point on Long Plain, Southern Tablelands, New South Wales, 27 Apr. 1984, K.D. Hill 740, L.A.S. Johnson & L.D. Pryor.

Names: Botanical—*pauciflora*, Latin *paucus* (few), *florus* (flowered), not really appropriate since this species often flowers profusely; *niphophila*, Greek *niphos* (snow), *philos* (loving); *debeuzevillei*, after the collector of the type material; *lacrimans* Latin (weeping), refers to the pendulous habit. Common—the most popular common name ‘snow gum’ refers to the habitat of the most extensive populations of these species.

Bark: Shed in irregular patches from the whole of the trunk and branches, leaving a smooth surface which may change colour from white or pink to yellow to dark grey, depending on the length of time exposed, giving a mottled effect; in many localities it is conspicuously marked by ‘scribbles’ caused by insect larvae.

Leaves: Seedling—opposite and sessile for about 2–5 pairs then alternate and petiolate, elliptical to ovate, 6–13 × 3–5 cm, greyish green or bluish green, concolorous or slightly discolorous. Juvenile—alternate, petiolate, ovate, 13–18 × 5–8.5 cm, pendulous, bluish green, concolorous. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 11–23 × 3–5 cm, green or bluish green, concolorous, with prominent longitudinal venation. Adult—alternate, petiolate, broad-lanceolate to lanceolate, or falcate, 8–16 × 1.2–2.5 cm (ovate to broad-lanceolate, uncinat, 5–10 × 1.2–3 cm for *niphophila*), green, glossy, concolorous, with prominent longitudinal venation.



Eucalyptus pauciflora: subsp. *pauciflora* (p), subsp. *niphophila* (n), subsp. *debeuzevillei* (d) 1. Trees (n), between Omeo and Bright, Vic. 2. Adult leaf venation (p) 3. Adult leaves (p) 4. Juvenile leaf (p) 5. Intermediate leaves (p) 6. Seedling (p) 7. Trees (d), summit of Mt Gingera, A.C.T. 8. Bark (p) 9. Buds (d) 10. Buds (p) 11. Tree (p), between Bulls Head and Mt Franklin, A.C.T. 12. Fruits (d) 13. Fruits (p)

Inflorescences: Simple, axillary 7–15 or more flowered; peduncles terete to angular, 0.3–1.6 cm long; pedicels absent or very short; buds (*pauciflora*, *niphophila*) clavate, $0.5\text{--}0.9 \times 0.3\text{--}0.5$ cm; (*debeuzevillei*) sessile and distinctly angular with longitudinal ribs, $0.9\text{--}1.5 \times 0.4\text{--}0.6$ cm; opercula hemispherical and apiculate, or conical, often pruinose. Flowers Oct.–Jan.

Fruits: Sessile or shortly pedicellate, ovoid, cupular or obconical (*debeuzevillei* sometimes slightly angular), $0.7\text{--}1.6 \times 0.7\text{--}1.4$ cm; disc broad, more or less level; valves generally 3, rim level or slightly below, often pruinose. Seeds pyramidal or obliquely pyramidal, black, hilum terminal.

Wood: Heartwood light pinkish brown, pale brown, wood may be streaky or patchy, rather light, comparatively soft, moderately strong but with many kino (gum) veins; grain straight to interlocked; density $510\text{--}670 \text{ kg m}^{-3}$; used locally

for fence posts and firewood but the species has more value in conserving the alpine ecosystems and in providing shelter for grazing animals.

Climate: Altitudinal range: near sea level to 2000 m; Hottest/coldest months: $17\text{--}26^\circ\text{C}/-8\text{--}6^\circ\text{C}$; Frost incidence: moderate to high (up to 200 each year with snowfalls common at high elevations); Rainfall: 600–1900 mm per year, winter max. to summer max. in the north of its range.

Distinctive features: A gum, with bark usually shed completely to ground level, often scribbly; blue ash-type seedlings; adult leaves thick, glossy, with veins almost parallel to the midrib; fruits with thick rims. Branchlets, buds and fruits are often pruinose, particularly in alpine forms. Weeping snow gum (*E. lacrimans*) is notable for the pendulous branchlets making it a popular ornamental.



Heavy snowfalls occur in the high country of the Australian Alps. 1–3. Pure stands of snow gum (*Eucalyptus pauciflora*) occur up to altitudes of around 1500 metres above sea level. 4. A pendulous form, weeping snow gum (*E. lacrimans*) is restricted to a small area in the Aaminaby-Kiandra area of N.S.W.

Blue Mountains Ash Smooth-barked Mountain Ash, White Ash

Eucalyptus oreades R.T. Baker

Blue Mountains ash is a medium-sized to tall tree of good form in relatively dense forest but develops large, heavily branched crowns in open-grown situations. It attains heights of 30–40 m and dbh to 1.8 m.

Blue Mountains ash has four major, quite disjunct areas of occurrence. These are the Blue Mountains area west of Sydney, the coastal escarpment inland from Port Macquarie, the Gibraltar Range between Grafton and Glen Innes and the Binna Burra, Springbrook, Mt Warning and Mt Barney areas, on both sides of the New South Wales–Queensland border. There is also a very small, isolated occurrence north-east of Tenterfield and a southernmost occurrence at Gibbergunyah Creek gorge, near Mittagong. The species occurs quite extensively in the Blue Mountains area but only in rather small patches elsewhere, often as ‘haloes’ around ridges on steep scarps with only a narrow altitudinal range.

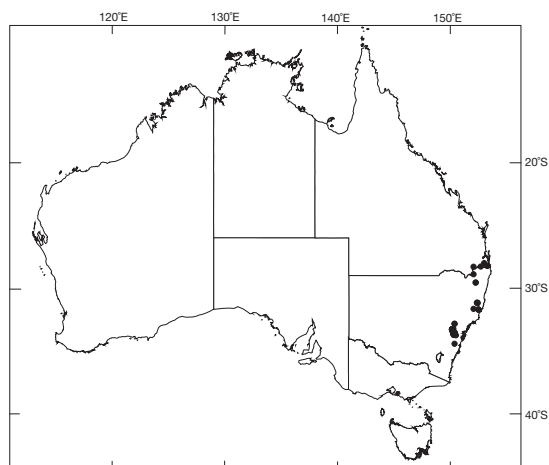
In the Blue Mountains region this species occurs mainly on Hawkesbury sandstones; good size and form are only attained where the soil is moderately deep and well drained. Deep red clay loams of volcanic origin are the usual soils in the rest of the distribution.

Blue Mountains ash occurs in open eucalypt forests often with silvertop ash (*E. sieberi*), broad-leaved peppermint (*E. dives*), Sydney peppermint (*E. piperita*), Blaxland’s stringybark (*E. blaxlandii*), narrow-leaved peppermint (*E. radiata* subsp. *radiata*), scribbly gum (*E. racemosa*), messmate stringybark (*E. obliqua*), tallowwood (*E. microcorys*) and New England blackbutt (*E. andrewsii*).

Related species: Brooker (2000) placed Blue Mountains ash, one of the tall tree species of the ‘blue ashes group’ in section *Cineraceae*. This group includes a variety of distinctive taxonomic series, which can be roughly categorised as the ‘typical blue ashes’, which includes the ‘snow gums’ (e.g. *E. pauciflora*), the silvertop ashes (e.g. *E. sieberi*) and the scribbly gums (e.g. *E. racemosa*). Within this section, Blue Mountains ash is placed in the series *Fraxinales*, which comprises three tree species and one mallee, yellow-top mallee ash (*E. luehmanniana*), which differs by its mallee habit, its thick, glossy green leaves, its pruinose buds and thick-rimmed fruits. The other trees are alpine ash (*E. delegatensis*), which is distinguished by the rough bark over the lower half of the trunk and the barrel-shaped fruits, and white ash (*E. fraxinoides*) of coastal mountains in southern New South Wales and just into Victoria at a lower altitude and which is distinct in the rough, black, compacted bark of the butt and the consistently urceolate fruits.

Publication: *Proc. Linn. Soc. N.S.W.* 24, 596 (1899). Type: Near Lawson, New South Wales, 22 Apr. 1899, R.T. Baker and H.G. Smith.

Names: Botanical—Oreades is the Greek name in mythology for mountain nymphs and alludes to the habitat. Common—refers to the major area of occurrence and the similarity of the timber with the ash (*Fraxinus*) of the northern hemisphere.



Bark: Smooth whitish to yellow bark, decortivating freely in long narrow strips from branches and trunk except for a fibrous basal stocking of 1–3 m.

Leaves: Seedling—opposite for 4–6 pairs, petiolate, ovate, 3.8–9 × 2.2–3.7 cm, pendulous dull bluish green or greyish green, discolorous. Juvenile—alternate, petiolate, ovate, 9–21 × 5.5–10 cm, dull greyish green, concolorous. Stems at seedling and juvenile stages are pruinose and have numerous raised oil glands. Intermediate—alternate, petiolate, broad-lanceolate, base oblique, 10–15 × 2.5–4 cm, dark green, concolorous. Adult—alternate, petiolate, lanceolate or falcate, base oblique, 11–17 × 1.5–2.3 cm, glossy green, concolorous.

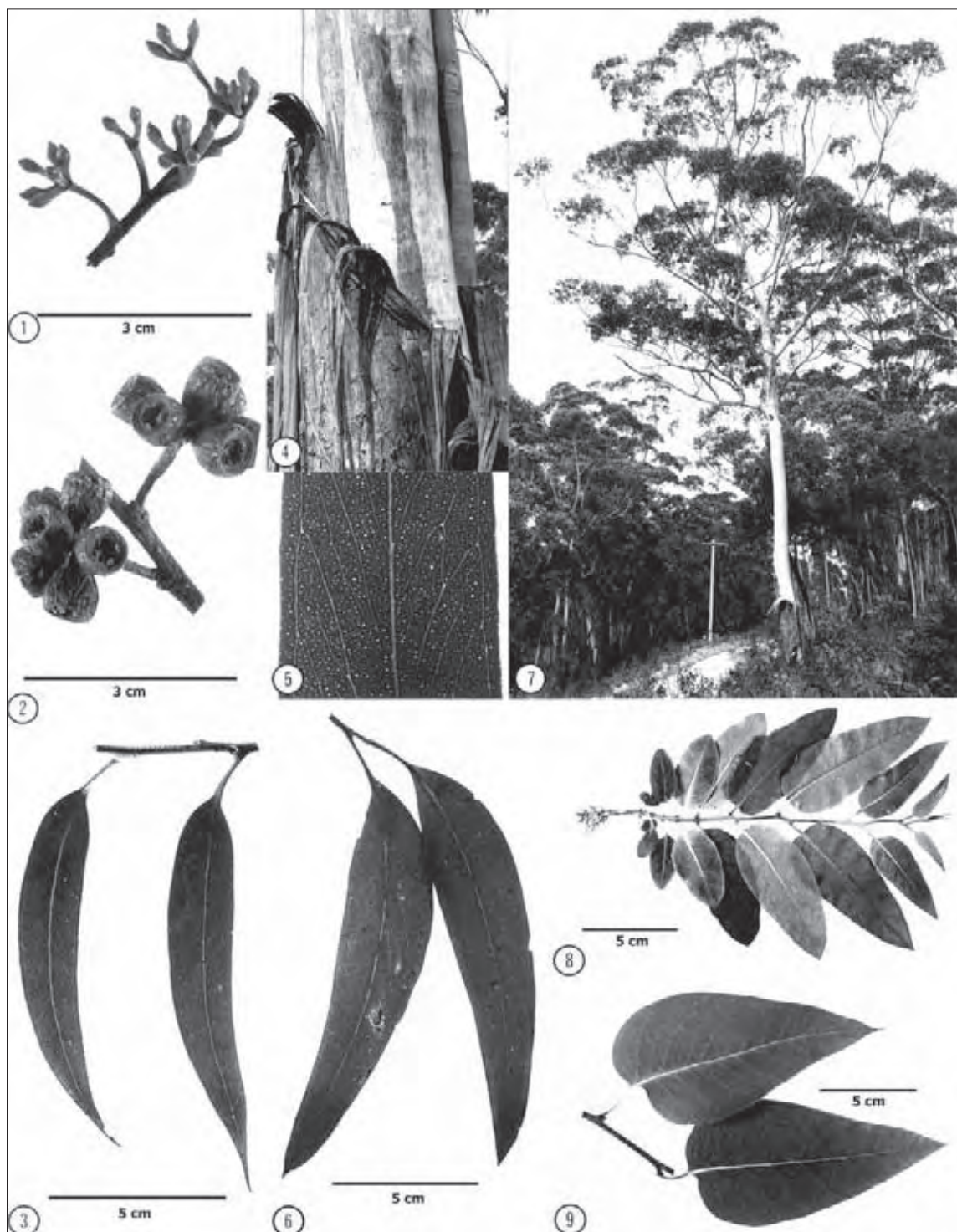
Inflorescences: Simple, axillary, 7-flowered; peduncles flattened, 0.9–2.5 cm long; pedicels absent or up to 0.2 cm long; buds clavate or broadly fusiform, often curved inwards, 0.6–0.7 × 0.3–0.4 cm; opercula conical or beaked. Flowers Jan.–Feb.

Fruits: Sessile or shortly pedicellate, cupular to slightly urceolate, 0.6–1 × 0.6–1 cm; disc broad, level to descending or below rim; valves 4 or 5, rim level or slightly enclosed. Seeds pyramidal or obliquely pyramidal, dark brown to black, hilum terminal.

Wood: Sapwood resistant to attack by *Lyctus* borers; heartwood pale yellow-brown (straw-coloured) with pink tonings, well-defined growth rings, moderately coarse-textured, moderately strong but not durable in the ground: basic density 505 kg m⁻³ (calculated air-dry density 610 kg m⁻³). Somewhat similar to alpine ash (*E. delegatensis*). Used for joinery but timber is scarce.

Climate: Altitudinal range: 750–1150 m; Hottest/coldest months: 23–28°C/–1–5°C; Frost incidence: moderate (with snow at high elevations); Rainfall: 850–1700 mm per year, summer–autumn max.

Distinctive features: A non-lignotuberous tree with bark shed in long, thin strips to leave a short, black, compacted, basal stocking of rough bark, smooth above; relatively large, lanceolate or falcate, glossy adult leaves with acute lateral venation; buds 7, curved, pointed; disc often prominent, horizontal but below rim level.



Eucalyptus oreades 1. Buds 2. Fruits 3. Adult leaves 4. Bark 5. Adult leaf venation 6. Intermediate leaves 7. Tree, near Blackheath, N.S.W. 8. Seedling 9. Juvenile leaves

Alpine Ash Woollybutt (Vic.), Blue Leaf (Tas.), White Top (Tas.)

Eucalyptus delegatensis R.T. Baker

Alpine ash is a tall to very tall tree usually 20–40 m in height, occasionally up to 90 m, with stem diameters of 2–3 m. The trees usually have straight stems with medium-sized crowns but very old trees typically have shorter boles, large branches and spreading crowns. Many stands are even-aged having regenerated after past bushfires. There are two subspecies.

Subspecies *delegatensis* is found from the Jounama and Brindabella Ranges in New South Wales and the Australian Capital Territory to eastern Victoria. Subsp. *tasmaniensis* is endemic to Tasmania (e.g. near Zeehan, Dazzler Range, Hartz Mountain, Mt Dromedary and on Maria Island off the east coast).

Alpine ash prefers well-drained, deep soils on moderately steep slopes and typically occurs on the sides of mountain ranges on the mainland and on the edges of plateaux in Tasmania. On the mainland the parent materials are commonly granites and less commonly basalts, porphyrys, phyllites and schists. Subsp. *tasmaniensis* commonly grows on dolerites.

This species grows in open or tall open forests, either in pure stands or associated with narrow-leaved peppermint (*E. radiata* subsp. *robertsonii*) and mountain gum (*E. dalrympleana*) at lower elevations, and snow gum (*E. pauciflora*) at higher elevations. In Tasmania, messmate (*E. obliqua*), mountain gum, Tasmania snow gum (*E. coccifera*), urn gum (*E. urnigera*), cider gum (*E. gunnii*) and Tasmanian alpine yellow gum (*E. subcrenulata*) are common associates, while on cooler, moister sites southern beech (*Nothofagus* spp.) may occur.

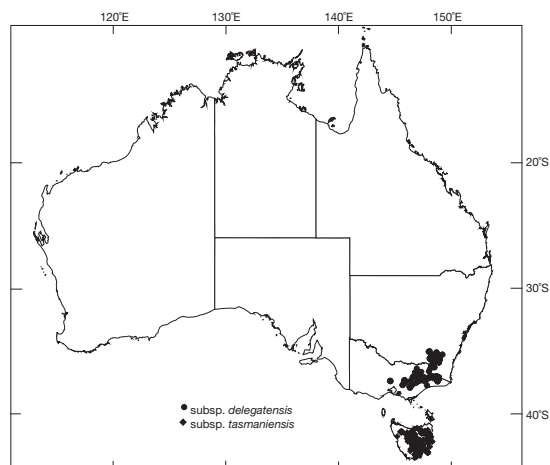
Related species: Alpine ash is one of the tall tree species in the 'blue ashes group', placed in section *Cinereae* by Brooker (2000). Alpine ash is easily distinguished from messmate (*E. obliqua*) which has rough bark over the whole trunk and branches and has glossy green leaves at all stages. The juvenile leaves and saplings of alpine ash resemble those of snow gums, the silver-top ashes, and white ash.

Publication: Subsp. *delegatensis*: *Proc. Linn. Soc. N.S.W.* 25, 305 (1900). Type: Delegate Mountain, New South Wales, Jan. 1899, W. Baeuerlen. Subsp. *tasmaniensis* Boland: *Austral. Forest Res.* 15, 177 (1985). Type: 31.7 km NW of Bothwell on Lakes Hwy, Tasmania, 5 Nov. 1974, G.M. Chippendale 1159 & A.M. Gray.

Names: Botanical—after the type area. Common—refers to habitat and to the similarity of the timber to ash (*Fraxinus*).

Bark: Rough and persistent on lower part of trunk, fibrous, dark-brown to grey, usually with longitudinal furrows, decorticating above in long strips to leave a creamy white gum bark on upper trunk with insect 'scribbles' (*delegatensis*). In subsp. *tasmaniensis* the bark is less furrowed and usually rough over the whole trunk.

Leaves: Seedling—shortly petiolate (*delegatensis*) or sessile (*tasmaniensis*), opposite for 4 or 5 pairs, elliptical to ovate, 5–13 × 2–7 cm, pruinose, discolorous. Juvenile—alternate, petiolate, varying from orbicular with a pointed tip to ovate,



depending on provenance, 13–25 × 6–10 cm, more or less pruinose, (pruinose juvenile leaves and stems and numerous raised oil glands in subsp. *tasmaniensis*), slightly discolorous. Intermediate—alternate, petiolate, broad-lanceolate, often oblique, 13–24 × 3.5–6 cm, green, concolorous. Adult—alternate, petiolate, lanceolate to falcate, often oblique, 9–18 × 1.8–3 cm (shorter and less falcate in subsp. *tasmaniensis*), green, glossy, concolorous. Adult leaves from Mt Macedon, Victoria, are markedly undulate and glossy-green in colour. Pendulous forms occur in the central plateau region of Tasmania.

Inflorescences: Simple, axillary, 7 to 15-flowered (commonly 11); peduncles terete to slightly angular, 0.9–2 cm long; pedicels 0.2–0.7 cm long; buds clavate, 0.5–0.6 × 0.3–0.4 cm; opercula hemispherical, often apiculate. Flowers Dec.–Mar.

Fruits: Pedicellate, barrel-shaped or hemispherical, 0.7–1.3 × 0.6–1.1 cm; disc relatively broad, level to descending; valves (3)4(5), enclosed. Seeds pyramidal or obliquely pyramidal, black, hilum terminal.

Wood: Sapwood up to 3 cm wide, almost white; heartwood yellow-brown or straw-coloured to pink-brown, usually straight-grained, with sparse tyloses and conspicuous growth rings, often with poreless zones in the early wood, moderately open-textured, stains and polishes well, easily worked being rather soft and light in weight; density 530–750 kg m⁻³; used for building framing, flooring, plywood and veneers, furniture, panelling, turnery, handles; and pulp for hardboard and paper, especially in Tasmania and Victoria. Wood can be similar in appearance to shining gum (*E. nitens*) and manna gum (*E. viminalis*)—see Ilic (1997).

Climate: Altitudinal range: 150–1500 m; Hottest/coldest months: 19–25°C/–4–3°C; Frost incidence: moderate to high (50–100 each year with snow at high elevations); Rainfall: 700–2500 mm per year, winter max.

Distinctive features: Non-lignotuberous forest tree with rough basal bark extending from one-quarter to two-thirds of the tree height; pruinose and pendulous juvenile and intermediate leaves; dark green, glossy adult leaves.



Eucalyptus delegatensis 1. Seedling 2, 4. Juvenile leaves 3. Intermediate leaf 5. Adult leaves 6. Buds 7. Stand (subsp. *delegatensis*), Leura Gap, A.C.T. 8. Fruits 9. Stand (subsp. *tasmaniensis*), north of Maydena, Tas. 10. Bark 11. Adult leaf venation

Yertchuk

Eucalyptus considaniana Maiden

Yertchuk rarely exceeds 30 m in height and 1 m dbh. Usually it is in the range 15–25 m and its form is somewhat poor, but on the best sites there may be a usable bole up to half the tree height. The crown tends to be open and rather straggly.

Yertchuk occurs in coastal New South Wales and parts of the adjoining tablelands (e.g. the Pigeon House Range), from Sydney and the Blue Mountains south to Gippsland in eastern Victoria and as far west as Yarram and Healesville.

This species is commonly found on poor and often skeletal soils, which are usually well drained. It occurs in foothills, lowland forests and heaths. The parent material includes sandstones, quartzites and poor shales. In its poorest form it occurs on poorly drained sands.

Yertchuk is usually a minor species in association with others, though on poorly drained, sandy sites it may be one of the more common constituents of open eucalypt forests. Associated eucalypts in New South Wales include a number of species, especially those that tolerate poor sites, such as white stringybarks (*E. globoidea* and allied species), scribbly gums (*E. racemosa*, *E. rossii*) and red bloodwood (*E. gummiifera*). On poor sites in Victoria it may be found with brown stringybark (*E. baxteri*). On somewhat better sites there may be narrow-leaved peppermint (*E. radiata*), silvertop ash (*E. sieberi*) and rough-barked apple (*Angophora floribunda*).

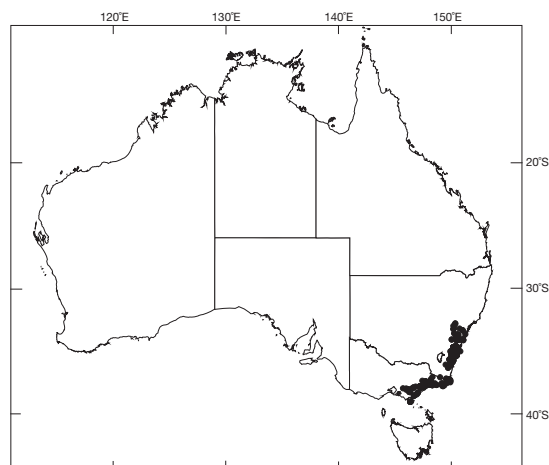
Related species: Brooker (2000) placed yertchuk, one of the smaller tree species in the 'blue ashes group', in section *Cineraceae*. It belongs in the series *Psathyroxylon*, which is diagnosed by the presence of staminodes in the buds, a rare character in subgenus *Eucalyptus*. Within this series it is allied to a group with rough bark, the other group being the easily distinguished, smooth-barked scribbly gums. It is related to and overlaps in distribution with silvertop ash (*E. sieberi*), which is distinguished by the thick, compact, dark rough bark on the trunk and the whitish smooth bark of the branches, compared with the peppermint type bark of yertchuk, which extends to the smaller branches. The seedlings of yertchuk are not pruinose compared with the pruinose seedlings of silvertop ash. The fruits of yertchuk are usually 4-valved, those of silvertop ash 3-valved.

Publication: *Proc. Linn. Soc. N.S.W.* 29, 475 (1904). Type: includes Wingello, New South Wales, 20 Dec. 1900, J.L. Boorman.

Names: Botanical—honours D. Considen (1760–1815), assistant surgeon with the first fleet (1788) and a keen naturalist. Common—of Aboriginal origin.

Bark: Rough and persistent to the small branches, peppermint-type, underlayers crisscrossed, moderately thin, fibres of medium length, grey over yellow or pinkish brown.

Leaves: Seedling—opposite and sessile for 4–8 pairs then alternate and shortly petiolate, the first few pairs of leaves more or less amplexicaul, elliptical to ovate, 5–13 × 2.5–5.5 cm, greyish green, discolorous. Juvenile—alternate, petiolate, ovate, often oblique, 13–17 × 4.5–8 cm, greyish green, slightly



discolorous. Intermediate—alternate, petiolate, broad-lanceolate, often oblique, 13–25 × 2.5–5.5 cm, green, concolorous. Adult—alternate, petiolate, lanceolate, often oblique, 8–13.5 × 1–2.5 cm, green, concolorous.

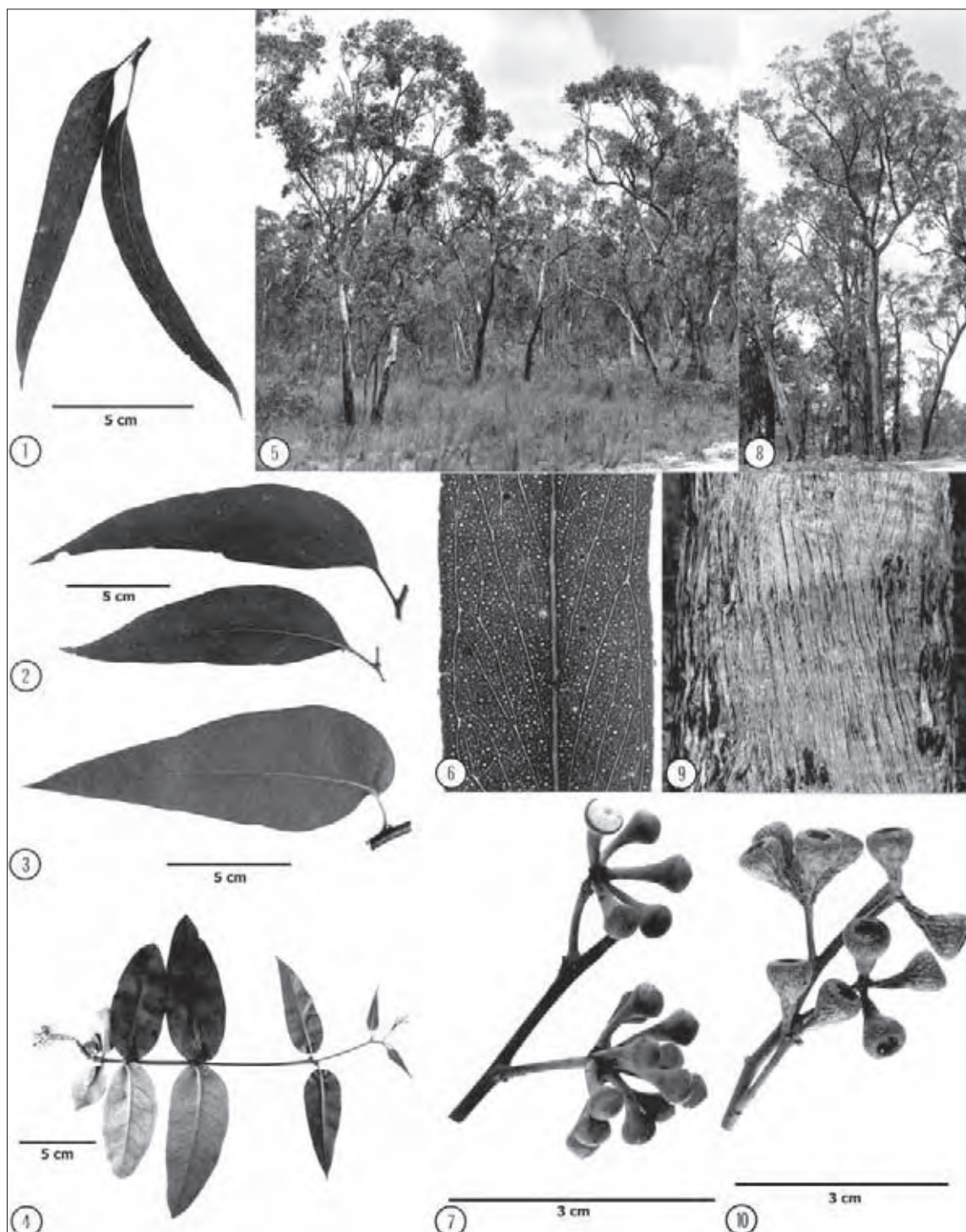
Inflorescences: Simple, axillary, 9 to 15-flowered; peduncles angular to flattened, 0.5–1.4 cm long; pedicels 0.3–0.5 cm long, though not always distinct due to gradual tapering into hypanthium; buds clavate, 0.5–0.7 × 0.3–0.4 cm; opercula hemispherical, apiculate. Flowers Oct.–Dec.

Fruits: Pedicellate (pedicels tend to be rather indistinct as they taper gradually into the base of the fruit), hemispherical or obconical, 0.5–1 × 0.6–0.8 cm; disc broad, more or less level, slightly domed, occasionally slightly ascending; valves (3)4(5), about rim level or very slightly exserted. Seeds pyramidal or obliquely pyramidal, black, brown or reddish brown, hilum terminal.

Wood: Sapwood rarely attacked by *Lyctus* borers; heartwood light brown, generally straight but sometimes interlocked grain, moderately coarse-textured, of moderate strength and durability, resistant to termites, kino (gum) veins frequent; density 710–1035 kg m⁻³; used for house framing, decking, fencing, railway sleepers and for firewood. Wood is very similar in appearance to silvertop ash (*E. sieberi*)—see Ilic (2002).

Climate: Altitudinal range: near sea level to 1000 m; Hottest/coldest months: 23–27°C/2–6°C; Frost incidence: low to moderate (10–40 each year and snow at high elevations); Rainfall: 700–1400 mm per year, uniform.

Distinctive features: Trees typically of rather poor form; persistent, grey, fibrous, peppermint-type bark; typical ash seedlings which are non-pruinose; non-pruinose stems; leaves with acute venation; buds clavate, stamens inflexed, staminodes may or may not be present; fruits obconical to pyriform with prominent disc, usually 4-valved.



Eucalyptus considiniana 1. Adult leaves 2. Intermediate leaves 3. Juvenile leaf 4. Seedling 5. Stand, south of Eden, N.S.W. 6. Adult leaf venation 7. Buds 8. Tree, near Orbost, Vic. 9. Bark 10. Fruits

Silvertop Ash

Silvertop, Black Ash (N.S.W.), Ironbark (Tas.), Yowut

Eucalyptus sieberi L.A.S. Johnson

Silvertop ash is commonly 25–35 m in height and 0.6–0.9 m dbh while on poor sites it may be reduced to 15 m. In contrast, on good forest soils in the foothill ranges, especially in the eastern Gippsland region of Victoria, some stands attain heights of over 45 m. At its best, form is usually good and the trunk may be half to two-thirds of the tree height.

Silvertop ash occurs in eastern Victoria between the Great Dividing Range and the sea and on the coast of New South Wales and adjacent ranges. It extends as far north as the Watagan Hills north-west of Wyong and extends west to near Collector on the Southern Tablelands. In Victoria a small population in the Pyrete Range north-west of Melbourne is the western limit. In Tasmania it occurs in the north-east of the State.

This species is found on undulating to hilly country from near sea level to the slopes of coastal ranges and tablelands. It grows on a wide range of soils and is usually found on poorer soils particularly those of a sandy type over a well-drained clay subsoil. While silvertop ash commonly occurs on sandstone or granite, other rock substrates include dolerite, quartzite, shale and siltstone.

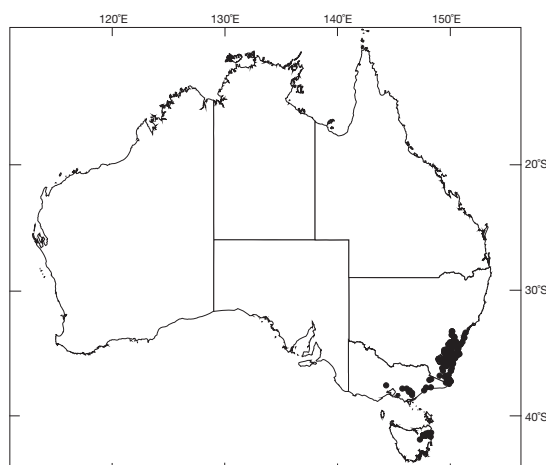
Silvertop ash inhabits open or tall open forests and woodlands, often in pure stands, but on the better sites it may be associated with other eucalypts such as messmate (*E. obliqua*), mountain grey gum (*E. cypellocarpa*), white ash (*E. fraxinoides*), mountain gum (*E. dalrympleana*) and, occasionally in the northern part of its range, blackbutt (*E. pilularis*), red bloodwood (*E. gummifera*) and Sydney peppermint (*E. piperita*). On poorer sites it may occur with scribbly gums (*E. haemastoma*, *E. racemosa*) and apples (*Angophora costata*, *A. floribunda* and *A. bakeri*).

Related species: Brooker (2000) placed silvertop ash, one of the taller tree species in the 'blue ashes group', in section *Cineraceae*. It belongs in the series *Psathyroxylon*, diagnosed by buds with inflexed stamens and staminodes (a rare character in subgenus *Eucalyptus*). It is related to and overlaps in distribution with yertchuk (*E. consideniana*), which is distinguished by the peppermint type bark which extends to the smaller branches and the non-pruinose seedlings. The fruits of *E. sieberi* are 3-valved, those of *E. consideniana* are usually 4-valved. Silvertop ash is most closely related to the mallee, *E. multicaulis*, which occurs from east of Rylstone west of Sydney, south to the Budawang Range east of Canberra.

Publication: *Contr. N.S.W. Natl Herb.* 3, 125 (1962). Type: Blackheath, New South Wales, Apr. 1899, J.H. Maiden.

Names: Botanical—honours F.W. Sieber (1789–1844) who made extensive collections of Australian plants in 1823. Common—from the colour of the smooth-barked branches, which contrasts with the dark bole.

Bark: Flaky, orange on the young trunks turning brown; dark grey to black, hard and deeply furrowed on the trunk and larger limbs of mature trees, smooth and white above.



Leaves: Seedling—opposite and sessile for 3–5 pairs, then becoming alternate and shortly petiolate, elliptical, 7–13 × 2–5.5 cm, greyish green or bluish green, slightly discolorous. Juvenile—alternate, petiolate, ovate, usually oblique, 12–17 × 4.5–7.5 cm, pendulous, greyish green or bluish green, becoming concolorous. Stems pruinose in seedling and juvenile stages; new growth bright pink. Intermediate—alternate, petiolate, broad-lanceolate, 13–20 × 2.7–4 cm, green, concolorous. Adult—alternate, petiolate, lanceolate or falcate, 9–15 × 1.2–2.8 cm, green, glossy, concolorous.

Inflorescences: Simple, axillary, 7 to 15-flowered; peduncles angular to flattened, 0.8–1.6 cm long; pedicels 0.1–0.4 cm long, not really distinct due to gradual tapering into hypanthium; buds clavate, 0.5–0.7 × 0.3–0.35 cm; opercula hemispherical, apiculate. Flowers Sept.–Jan.

Fruits: Pedicellate, obconical, 0.8–1.2 × 0.7–0.9 cm; disc relatively broad, more or less level or slightly descending or slightly ascending; valves 3, slightly enclosed. Seeds pyramidal or obliquely pyramidal, black, hilum terminal.

Wood: Sapwood narrow, not easily distinguished, up to 2.5 cm wide, susceptible to attack by *Lyctus* borers; heartwood light brown, sometimes with pink tinges, with distinct growth rings, grain occasionally interlocked, more difficult to season than other ash species; density about 830 kg m⁻³; used for structural engineering, bridges, wharves, fencing, railway sleepers, flooring, plywood, crates and pulp. See Ilıc (2002) for more information on the wood of this species.

Climate: Altitudinal range: near sea level to 1100 m; Hottest/coldest months: 22–27°C/–2–5°C; Frost incidence: moderate to high (10–60 each year and snow at high elevations); Rainfall: 700–1400 mm per year, uniform to winter max.

Distinctive features: A non-lignotuberos eucalypt; young bark is notably flaky and is bright orange when fresh; bark of mature tree dark, compacted and contrasts with smooth white upper bark; seedlings typically ash-like; adult leaves green, fairly glossy, with acute venation; buds clavate, stamens inflexed, outer filaments barren (staminodes); fruits obconical, valves 3.



Eucalyptus sieberi 1. Adult leaf venation 2. Adult leaves 3. Seedling 4. Bark 5. Intermediate leaves 6. Juvenile leaf 7. Buds 8. Stand, east of Orbost, Vic. 9. Fruits

White Ash White Mountain Ash

Eucalyptus fraxinoides Deane & Maiden

White ash on cool and moist sites is a tall tree, attaining 40 m in height and a dbh up to 1 m. Elsewhere, as in exposed situations at higher altitudes, it may be reduced to a smaller and somewhat bushy tree 10–20 m tall. At its best it has an erect trunk of good form half or more of the tree height.

White ash grows in New South Wales in a belt about 250 km long and 30–60 km wide, south from Sassafras to the eastern extremity of Victoria in the Howe Range, east of Mallacoota. A southern outlier occurs in coastal East Gippsland, Victoria, at Croajingolong National Park.

Chromosols (brown podzolic) and tenosols (transitional alpine humus soils) are the main types on which white ash grows to a large tree. At the highest altitudes the trees grow in pure stands on shallow soil among granite rocks where the trees characteristically assume a leaning habit. In the Howe Range it grows in gullies and on ridges. Other rock substrates include sandstone, conglomerates and quartzite.

White ash occurs in open to tall open forests, mainly in pure stands or associated with other eucalypt species such as mountain grey gum (*E. cypellocarpa*), messmate (*E. obliqua*), brown barrel (*E. fastigata*) and, less commonly, with silvertop ash (*E. sieberi*) and narrow-leaved peppermint (*E. radiata*).

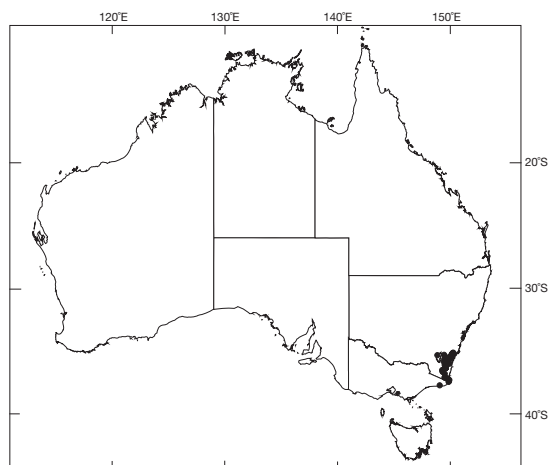
Related species: White ash is one of the taller tree species in the 'blue ashes group', placed in section *Cineraceae* by Brooker (2000). This group includes a variety of distinctive taxonomic series, such as the snow gums (e.g. *E. pauciflora*), the silvertop ashes (e.g. *E. sieberi*), and the scribbly gums (e.g. *E. racemosa*). This species is placed in series *Fraxinales*, which comprises three tree species and one mallee—yellow-top mallee ash (*E. luehmanniana*) which is easily distinguished by its mallee habit, its thick, glossy green leaves, its pruinose buds and thick-rimmed fruits. The other trees are alpine ash (*E. delegatensis*) of subalpine situations and which is distinguished by the rough bark over the lower half of the trunk and the barrel-shaped fruits, and Blue Mountains ash (*E. oreades*) which occurs from the Gibbergunyah Creek gorge, near Mittagong, north to the far south-east of Queensland, and which differs by its shorter rough-barked stocking (to only 3 m), the buds which are slightly incurved and the cupular to slightly urceolate fruits.

Publication: *Proc. Linn. Soc. N.S.W.* 23, 412 (1898). Type: Tantawango Mountain, New South Wales, Dec. 1896, H. Deane and J.H. Maiden.

Names: Both the botanical and common names allude to the similarity of the timber to the ash (*Fraxinus*) of the northern hemisphere.

Bark: Lower bark dark grey, compact, not conspicuously fissured, persistent to 3–5 m, smooth above and usually marked by conspicuous insect 'scribbles'; the persistent basal bark tends to become somewhat rough and more fissured with age.

Leaves: Seedling—opposite for about 2–4 pairs then alternate, sessile for 1–3 pairs then petiolate, elliptical to ovate, 7–13 ×



2–4 cm, pale green or bluish green, slightly discolorous.

Juvenile—alternate, petiolate, ovate to broad-lanceolate, 11–20 × 3–6.5 cm, pendulous, pale green or bluish green, concolorous; immature leaves at top of sapling pink to red.

Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 15–20 × 2–4 cm, green, glossy, concolorous.

Adult—alternate, petiolate, lanceolate to narrow-lanceolate or falcate, usually uncinuate, 8–16 × 1–2 cm, green, concolorous.

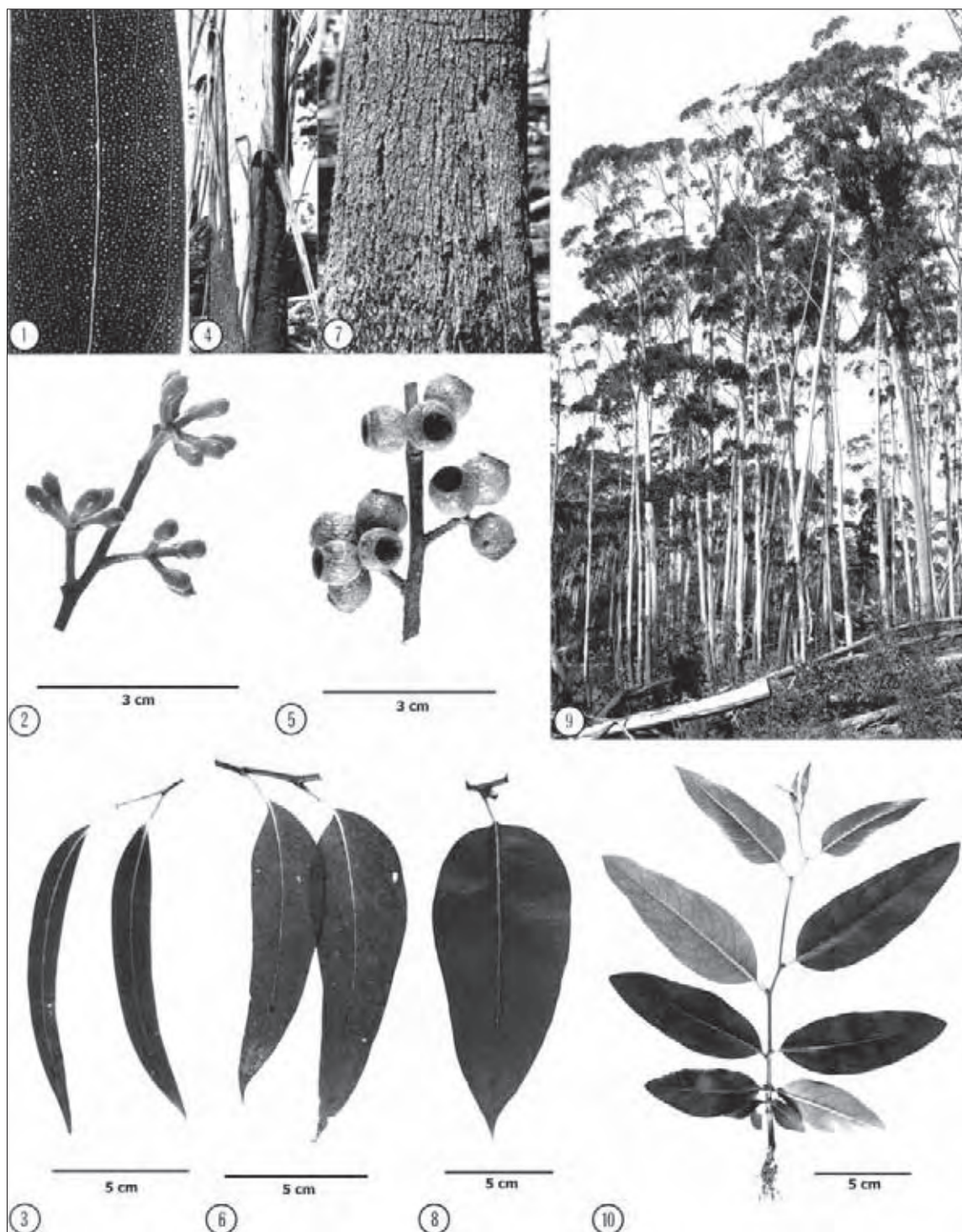
Inflorescences: Simple, axillary, 7 to 11-flowered; peduncles angular to flattened, 0.5–1.8 cm long; pedicels 0.1–0.6 cm long; buds ovoid to clavate, 0.6–0.7 × 0.3 cm; opercula conical or hemispherical-apiculate. Flowers Dec.–Jan.

Fruits: Pedicellate, urceolate or rarely globular, 0.7–1.1 × 0.6–1.1 cm; disc relatively broad, steeply descending; valves 4 or 5, deeply enclosed. Seeds pyramidal or obliquely pyramidal, black, hilum terminal.

Wood: Sapwood susceptible to attack by *Lyctus* borers; heartwood straw-coloured to light brown, coarse to moderately coarse-textured, usually straight-grained, of low durability; density 580 kg m⁻³; used for joinery, flooring and general construction. Very similar in appearance to alpine ash (*E. delegatensis*) but not pinkish.

Climate: Altitudinal range: 150–1000 m; Hottest/coldest months: 23–27°C/–2–2°C; Frost incidence: moderate to high (10–90 per year and snow at elevations above 700 m); Rainfall: 800–1100 mm per year, uniform.

Distinctive features: Non-lignotuberous trees of slopes and rocky mountain tops often in pure stands, often leaning; bark dark, compact, persistent for up to 5 m, smooth white with scribbles above; typical dull bluish green ash seedlings, not as pruinose as *E. sieberi* which may grow nearby, fresh growth conspicuously red; fruits globular to urceolate; seed black.



Eucalyptus fraxinoides 1. Adult leaf venation 2. Buds 3. Adult leaves 4. Bark (transition from lower, rough bark to upper, smooth bark) 5. Fruits 6. Intermediate leaves 7. Lower bark, mature tree 8. Juvenile leaf 9. Stand, Brown Mountain, between Nimmitabel and Bega, N.S.W. 10. Seedling

New England Blackbutt

Eucalyptus andrewsii Maiden

New England blackbutt on good sites is an erect tree to 45 m tall and dbh up to 2 m. The crown is of moderate width and density. In cold and poorer sites it may be only 20 m with a shorter trunk but wider, less compact crown. There are two subspecies, the typical and subsp. *campanulata*.

Subsp. *andrewsii* occurs principally on the Northern Tablelands of New South Wales and the adjacent high country of Queensland (Stanthorpe–Warwick–Toowoomba). There are sporadic occurrences farther north in Queensland in the Kroombit Range, south-west of Gladstone, Biggenden Bluff (west of Maryborough) and near Eungella (west of Mackay). Subspecies *campanulata* occurs in the ranges and the eastern side of the Northern Tablelands of New South Wales and possibly into far south-eastern Queensland.

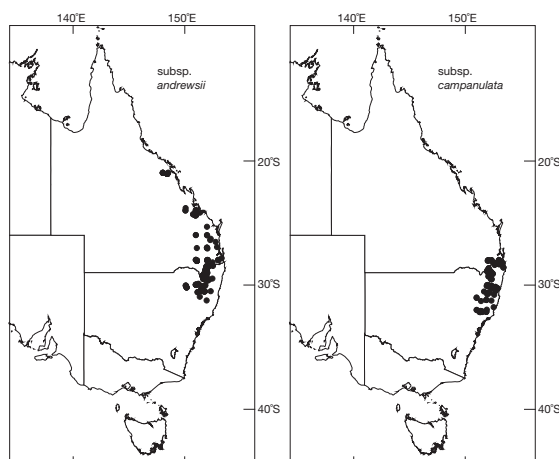
The topography is undulating to somewhat hilly. The soils mainly have strongly differentiated profiles with a bleached subsurface horizon (duplex or podzolic types) and vary from moderately deep loamy sands of good fertility by forest criteria, to skeletal. The parent rock material is mainly granite, but there is some quartz porphyry and basalt.

New England blackbutt grows in open or tall open eucalypt forests or in eucalypt woodland on poorer soils. Stringybarks (e.g. *E. macrorhyncha*, *E. caliginosa*, *E. youmanii* and *E. mckieana*) are common associates and other species include white box (*E. albens*), red ironbark (*E. sideroxylon*), silver-leaved ironbark (*E. melanophloia*), rough-barked apple (*Angophora floribunda*) and, on lower drainage lines, red gums (e.g. *E. blakelyi*, *E. prava*).

Related species: New England blackbutt is one of the taller tree species in the 'blue ashes group', placed in section *Cineraceae* by Brooker (2000). It belongs in the series *Psathyroxylon*, diagnosed by buds with staminodes (an unusual character in subgenus *Eucalyptus*), although this character is rare in this species. Within this series it is allied to a group with rough bark, the other group being the easily distinguished, smooth-barked scribbly gums (e.g. *E. racemosa*). New England blackbutt is related to silvertop ash (*E. sieberi*), which differs in the compacted rough bark and larger buds and fruits. The bark of New England blackbutt is a peppermint-type, but the blue ash type seedlings and juvenile leaves easily distinguish it from the true peppermints (e.g. *E. radiata*). Subspecies *andrewsii* has hemispherical fruits which distinguish it from subspecies *campanulata* which has obconical fruits resembling small silvertop ash fruits in shape. The Queensland form of *E. andrewsii* has been published as *E. montivaga* by Bean (1997), but the differences from subsp. *andrewsii* are minor.

Publication: *E. andrewsii*, *Proc. Linn. Soc. N.S.W.* 29, 472 (1904). Type: Tingha, New South Wales, 16 Oct. 1903, R.H. Cambage. Subsp. *campanulata* (R.T. Baker and H.G. Smith) L. A.S. Johnson & D.F. Blaxell: *Contrib. N.S.W. Natl Herb.* 4, 381 (1973). Type: Tenterfield, New South Wales, Dec. 1909, C.F. Lason.

Names: Botanical—*andrewsii*, honours E.C. Andrews (1870–1948), geologist and botanist in New South Wales;



campanulata, Latin *campanulatus* (bell-shaped), in reference to the fruit shape. Common name—refers to the New England tablelands, a common habitat of both subspecies.

Bark: Rough and persistent on the trunk and larger branches, peppermint-type, smaller limbs smooth, whitish, often with ribbons of partly decorticated bark hanging in the canopy.

Leaves: Seedling—opposite for 3 or 4 pairs then alternate, petiolate, elliptical to ovate, 7–15 × 3–6.5 cm, greyish green, slightly discolorous. Juvenile—alternate petiolate, ovate, 10–20 × 3.5–9 cm, pendulous, greyish green. Intermediate—subopposite to alternate, petiolate, broad-lanceolate to almost ovate, 10–15 × 3.8–6.5 cm, but sometimes with an oblique base and up to 7.5 cm wide, bluish green or grey-green, concolorous. Adult—alternate, petiolate, lanceolate or falcate, 10–16 × 1.2–2.5 cm, bluish green or grey-green (*andrewsii*), green or grey-green (*campanulata*), concolorous.

Inflorescences: Simple, axillary, 11 to 15-flowered; peduncles terete to angular, 0.5–2 cm long; pedicels 0.3–0.6 cm long; buds clavate, slightly pruinose (*andrewsii*), 0.4–0.5 × 0.25–0.3 cm; opercula hemispherical, apiculate, Flowers Nov.–Feb.

Fruits: Pedicellate, hemispherical, 0.4–0.5 × 0.5–0.6 cm (*andrewsii*); obconical, 0.6–0.8 × 0.4–0.6 cm (*campanulata*); disc relatively broad, more or less level, valves 4 or 5, about rim level. Seeds dark brown, pyramidal or obliquely pyramidal, hilum terminal.

Wood: Sapwood very pale brown, up to 7.5 cm wide, susceptible to attack by *Lyctus* borers; heartwood light brown, of moderately fine texture, kino (gum) veins common, durable to moderately durable; density 725–1030 kg m⁻³; used for general building construction and occasionally for veneer.

Climate: Altitudinal range: 400–1250 m; Hottest/coldest months: 25–30°C/–2–3°C; Frost incidence: moderate to high (40–70 each year and snow at high elevations); Rainfall: 750–1800 mm per year, summer max.

Distinctive features: Peppermint-type bark; typical ash seedlings; intermediate and adult leaves, twigs and buds slightly pruinose for subsp. *andrewsii*; long pedicels; buds small, clavate, staminodes rare; fruits hemispherical (*andrewsii*) or obconical (*campanulata*).



Eucalyptus andrewsii: subsp. *andrewsii* (a), subsp. *campanulata* (c) 1, 6. Bark (c) 2. Adult leaves (a) 3. Intermediate leaf (c) 4. Seedling (a) 5. Buds (c) 7. Juvenile leaves (c) 8. Fruits (c) 9. Tree (c), Girard State Forest, near Tenterfield, N.S.W. 10 Adult leaf venation (c) 11. Fruits (a)

Scribbly Gum Snappy Gum, White Gum

Eucalyptus rossii R.T. Baker & H. G. Smith

Scribbly gum at its best is a medium-sized tree, up to 25 m tall, with a dbh of 1 m. On poor sites where it is more commonly found, the tree may be only 10–15 m tall, with a short, crooked bole and a heavy, irregularly branched crown.

This species is the only scribbly gum with an inland distribution; it occurs on the western slopes and parts of the adjacent tablelands of New South Wales, from the border with Queensland almost to that of Victoria.

This is a species found on low ridges in undulating foothills of mountainous areas; occasionally it extends to small flats and valley bottoms. The soils on which it grows are frequently skeletal, well drained and of little value for pastures. Soils are derived from a wide range of parent materials particularly metamorphics.

Scribbly gum usually occurs in open forests or woodlands, particularly on relatively harsh, dry sites. It may be associated with red stringybark (*E. macrorhyncha*), red box (*E. polyanthemos*), bundy (*E. nortonii*), brittle gum (*E. mannifera*) and red ironbark (*E. sideroxylon*).

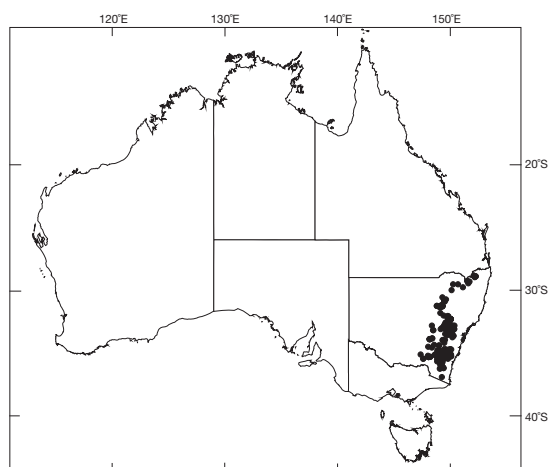
Related species: Scribbly gum is one of the smaller tree species of the 'blue ashes group', placed in section *Cineraceae* by Brooker (2000). It belongs in series *Psathyroxylon*, which is diagnosed by buds with inflexed stamens and staminodes (an unusual character in subgenus *Eucalyptus*). Within this series it is clearly distinct from the rough-barked species (e.g. *E. sieberi*). *E. rossii* differs from the two other 'scribbly gums', *E. haemastoma* by the narrower juvenile leaves and smaller buds and fruits, and from *E. racemosa*, by having narrower juvenile leaves. Being a white gum, it is often confused with the quite unrelated and often co-occurring brittle gum (*E. mannifera*) from which it is distinguished by the scribbly, non-powdery bark, sparse leaf reticulation, and hemispherical (not conical) opercula. Pfeil and Henwood (2004) recognise *E. rossii* as a subspecies of *E. racemosa*.

Publication: *Research Euc.* 70 (1902). Type: Cow Flat, Bathurst, Mar. 1901, R.T. Baker.

Names: Botanical—honours W.J.C. Ross (1850–1914), a teacher at Bathurst Technical College. Common—refers to 'scribbles', a common feature of the bark surface (see below).

Bark: Shed from all parts of the tree; sometimes showing mottled tones when the outer bark has been shed at different times, often brilliant yellow at first, weathering to white and finally grey, usually with 'scribbles', i.e. tunnel marks left by insect larvae which burrow underneath the bark and are exposed once the top layer of bark sheds.

Leaves: Seedling—opposite for 5 or 6 pairs then alternate, sessile for 2–5 pairs then petiolate, elliptical to broad-lanceolate, 7–13.5 × 1.6–4.5 cm, greyish green, slightly discolorous. Juvenile—alternate, petiolate, broad-lanceolate to lanceolate, 10–14 × 2.5–4.5 cm, greyish green, becoming concolorous. Intermediate—alternate, petiolate, broad-lanceolate to lanceolate, 9–16 × 2–2.8 cm, greyish green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, sometimes falcate, 7–15 × 0.8–1.3 cm, slightly glossy, greyish green, concolorous.



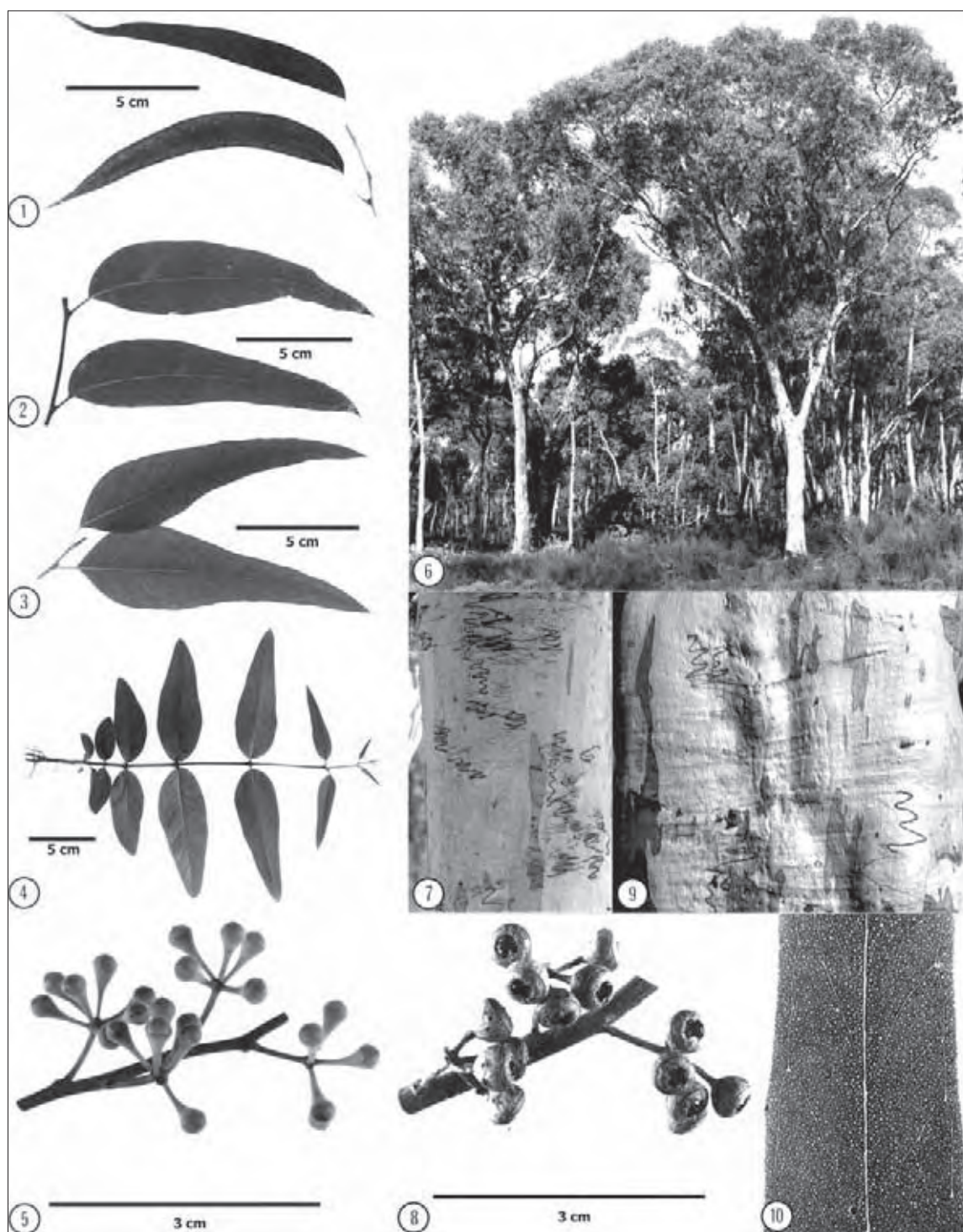
Inflorescences: Simple, axillary, 9 to 15-flowered; peduncles slender, terete to angular, 0.3–0.5 cm long; pedicels slender, 0.3–0.5 cm long; buds clavate, 0.4–0.5 × 0.2–0.3 cm; opercula hemispherical, usually apiculate. Flowers Dec.–Feb.

Fruits: Pedicellate, subglobular to hemispherical, 0.4–0.5 × 0.5–0.6 cm; disc broad, more or less level or slightly ascending, usually convex; valves 4, about rim level. Seeds brown to red-brown, pyramidal or obliquely pyramidal, hilum terminal.

Wood: Somewhat brittle, not a commercial species; used for local farm purposes such as temporary fencing but not highly regarded as a fuelwood species.

Climate: Altitudinal range: 300–1000 m; Hottest/coldest months: 26–33°C/–2–3°C; Frost incidence: moderate to high (10–50 each year and snow at high elevations); Rainfall: 550–850 mm per year, uniform to summer max.

Distinctive features: Small to medium-sized tree; whitish bark with 'scribbles', adult leaves with acute side venation and little reticulation; opercula hemispherical; smallish, subglobular fruits often with a reddish disc; staminal filaments inflexed, outer ones sterile (staminodes).



Eucalyptus rossii 1. Adult leaves 2. Intermediate leaves 3. Juvenile leaves 4. Seedling 5. Buds 6. Stand, between Coonabarabran and Narrabri, N.S.W. 7, 9. Bark 8. Fruits 10. Adult leaf venation

Sydney Peppermint

Eucalyptus piperita Sm.

Sydney peppermint varies from a short, heavily branched tree of poor form only 6–12 m tall with a crown nearly as wide to a well-shaped forest tree up to 30 m tall with a trunk more than half the tree height. It forms a crown of dull green to bluish green leaves. There are two subspecies, the typical and subsp. *urceolaris*.

Sydney peppermint is endemic to the coastal plains, ranges and eastern side of the tablelands of New South Wales, from Batemans Bay south of Sydney north to Napiac south of Taree, and including the Blue Mountains. It is mainly found within 80 km of the coast. Subsp. *piperita* is the northern form occurring from the Central Tablelands northwards, while subsp. *urceolaris* occurs south from the Central Tablelands. The two forms intergrade where occurrences overlap.

Sydney peppermint favours valleys and sheltered slopes, but is also found on the gently undulating topography of the tablelands. The largest trees are found on sandy clays and loams of moderate depth, which do not dry out. Poorer-formed trees occur on shallow sandy soils on sandstone plateaux.

It grows in open eucalypt forests and associated species are numerous. On poorer sites these include red bloodwood (*E. gummifera*), scribbly gums (*E. haemastoma*, *E. racemosa*), silvertop ash (*E. sieberi*), stringybarks and smooth-barked apple (*Angophora costata*). Where conditions are more favourable for forest growth there may be messmate (*E. obliqua*), mountain grey gum (*E. cypellocarpa*), manna gum (*E. viminalis*) and turpentine (*Syncarpia glomulifera*).

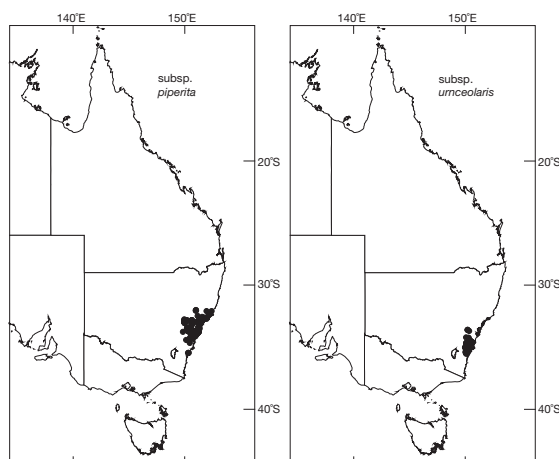
Related species: Sydney peppermint belongs to the 'blue ashes' (section *Cineraceae*) but is isolated in a series (*Piperitales*), as it is not closely related to other species in the section (Brooker 2000). The trees are rough-barked on the trunk and larger limbs, or sometimes half-barked and may be confused on this account with silvertop ash (*E. sieberi*), which has much thicker, compacted rough bark. It may resemble various stringybarks, which differ in the much thicker, loosely stringy rough bark. In common with many blue-leaved ashes, the juvenile growth is conspicuous in the field for the large, pendulous, alternating, dull juvenile leaves which can be confused with the scribbly gums (completely smooth-barked) and the silvertop ashes. The juvenile leaves of the stringybarks are clearly distinguished by their smaller size, undulation and pubescence.

Publication: In J. White, *J. Voy. New South Wales* 226 (1790). Type: Port Jackson, New South Wales, J. White.

Names: Botanical—Latin, *piperitus* (pepper-like), presumably referring to the peppermint smell of the crushed leaves. Common—refers to the area where it was first discovered and to smell of the crushed leaves.

Bark: Rough on the trunk and larger limbs, finely fibrous, greyish; upper branches smooth, white or greyish.

Leaves: Seedling—opposite for 5–7 pairs, sessile, broadly ovate, 5–11 × 3–6 cm, dull, green, discolourous. Juvenile—alternate, petiolate, pendulous, ovate or broadly falcate and



oblique, 4–16 × 2–7, dull, bluish green, discolourous. Intermediate—alternate, petiolate, broad-elliptic to broad-lanceolate, 5–8 × 2.5–3.5 cm, base oblique, glossy, dull, green or bluish green, initially discolourous but later concolourous. Adult—alternate, petiolate, falcate and oblique, 7–20 × 2–3 cm, glossy or dull, green or bluish green, concolourous.

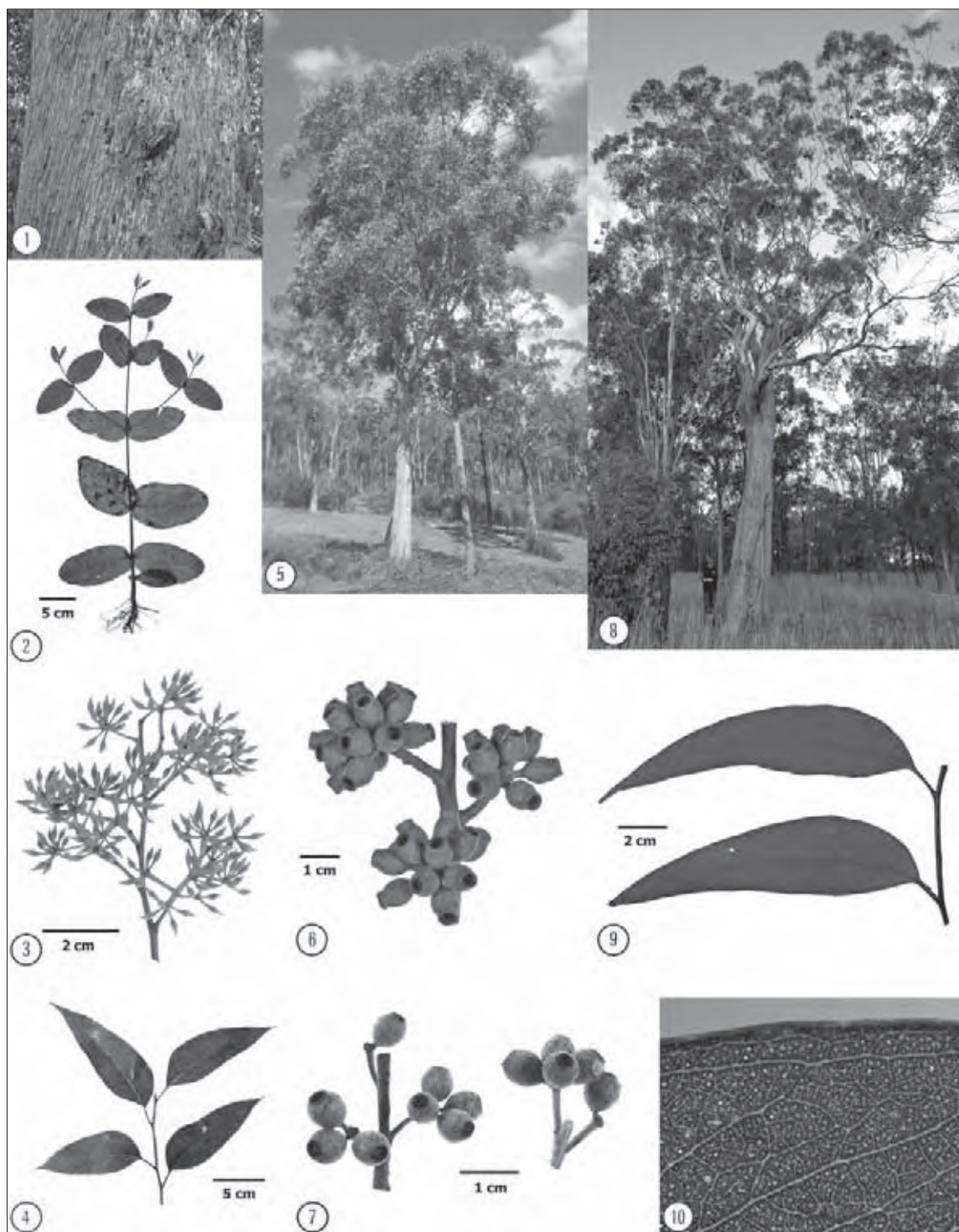
Inflorescences: Simple, axillary, 7 to 15-flowered; peduncles flattened, 0.5–2.5 cm long; buds fusiform, often curved, 0.3–0.8 × 0.2–0.3 cm; opercula conical or beaked. Flowers Nov.–Feb.

Fruits: More or less sessile or pedicellate, barrel-shaped (*piperita*), urceolate (*urceolaris*), 0.6–0.8 × 0.4–0.7 cm; disc descending; valves (3)4, deeply enclosed. Seeds pyramidal or obliquely pyramidal, dark brown to black, hilum terminal.

Wood: Pale to light brown, fairly hard and tough but subject to kino (gum) veins; of moderate strength and durability; density 500–980 kg m⁻³; not an important commercial species, but its timber, which is comparable to narrow-leaved peppermint (*E. radiata*), is used locally for light construction; the tendency for gum veins prevents its use where appearance is important.

Climate: Altitudinal range: near sea level to 900 m; Hottest/coldest months: 24–25°C/1–4°C; Frost incidence: low to moderate (up to 50 each year at inland sites); Rainfall: 800–1250 mm per year, uniform.

Distinctive features: Small to medium-sized tree, with finely fibrous, greyish rough bark on trunk and larger limbs; upper branches smooth, white or greyish; juvenile leaves conspicuously petiolate, broad, pendulous, dull, bluish green; inflorescences axillary, 7–15 budded, buds fairly crowded, pointed and often curved.



Eucalyptus piperita: subsp. *piperita* (p), subsp. *urnceolaris* (u) 1. Bark 2. Seedling 3. Buds 4. Juvenile leaves 5. Tree, near Nelligen, N.S.W. (u) 6. Fruits (u) 7. Fruits (p) 8. Tree, near Bulga, N.S.W. (p) 9. Adult leaves 10. Adult leaf venation

■ Peppermints

Eucalyptus section *Aromatica* Brooker

The peppermints comprise a small, fairly distinctive group of about 15 species, which are almost exclusively confined to New South Wales, Victoria and Tasmania. The exceptions are narrow-leaved peppermint (*E. radiata* subsp. *radiata*), which extends to south-eastern Queensland, and *E. willisii*, which extends westwards from south-eastern Victoria to the south-east of South Australia.

The preferred habitats of peppermints are similar to those of the ashes, that is, where the climate is cool to mild and the sites are moist.

The group has a wide altitudinal range from near sea level in Tasmania, South Australia and Flinders Island in Bass Strait, to the subalpine forests and woodlands of eastern Victoria and southern New South Wales. *E. radiata* is the most widespread species of peppermint, occurring from Queensland to central Victoria, while *E. radiata* subsp. *robertsonii* is adapted to the mountains of southern New South Wales and eastern Victoria. River peppermint (*E. elata*) is notable for its adaptation to moist gullies and river banks and is among the tallest species of peppermint on the mainland. A few species are endemic to Tasmania and the fine-leaved white peppermint (*E. pulchella*) is a popular ornamental. The most variable species is Smittthorn peppermint (*E. nitida*), which is a tall tree in western Tasmania and a mallee in other parts of the State such as the Sentinel Range and Devils Kitchen.

A few species, viz. *E. elata*, *E. radiata* subsp. *robertsonii*, *E. nitida* and black peppermint

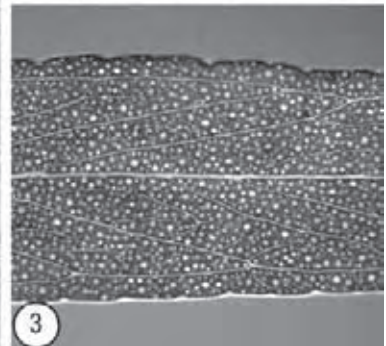
(*E. amygdalina*), attain dimensions suitable for forestry, but the group is better known for the leaf oils. The leaves are conspicuously glandular and those of broad-leaved peppermint (*E. dives*), narrow-leaved peppermint (*E. radiata*) and river peppermint (*E. elata*) are distilled, the oils being used in pharmacy, perfumery and industry.

Botany

Most peppermint species, particularly mainland species, are notable for their 'peppermint' bark which is persistent, rather short-fibred, moderately thin, with inner layers finely interlaced, at first brownish weathering to grey. In contrast, *E. elata* has only the lower bole with persistent rough bark, which becomes characteristically compacted, and *E. pulchella* is usually wholly smooth-barked although large, old trees may be fibrous-barked at the base. *E. tenuiramis* and *E. risdonii* are also mostly smooth-barked. Heterophylly is fairly strong in the group but not so marked as in section *Maidenaria*.

All species have many pairs of opposite juvenile leaves. These are green and narrow in *E. radiata* and *E. elata*, broad and bluish-green in *E. dives* and round and pruinose in Risdon peppermint (*E. risdonii*), which being mature in the juvenile phase, is popular as an ornamental species. The adult leaves are strongly glandular and give a strong peppermint smell on being crushed. The stems of seedlings are usually warty with glandular protuberances.

The inflorescences are axillary and multi-flowered. In *E. elata* their large numbers produce balls of white flowers which, with the attractive narrow, pendulous leaves, make the species a beautiful ornamental.



Peppermints are confined to the south east of the continent, with a number endemic to Tasmania. 1. A large stand of silver peppermint (*E. tenuiramis*) amid mixed eucalypt forest, near Steppes, Tas. 2. A pure stand of black peppermint (*E. amygdalina*), near Bothwell, Tas. 3. Transmitted light through a leaf of narrow-leaved peppermint (*E. radiata*) reveals numerous oil glands which are rich in piperitone. 4. The basal bark of river peppermint (*E. elata*) has the distinctive rough bark typical of species in this group.

Silver Peppermint

Eucalyptus tenuiramis Miq.

Silver peppermint is a small to medium-sized tree 8–25 m in height and up to 1 m dbh. The trunk is typically fairly straight but short, dividing at one-quarter to half the tree height into several large, ascending stems, which form the framework of a wide, moderately dense crown. The finer branchlets are pendulous and in some specimens may almost reach the ground.

Silver peppermint is a fairly common eucalypt of the lowlands and hills of south-eastern Tasmania, where it is most common, especially north-west of Hobart in the hills of the Derwent River catchment and the Freycinet Peninsula area.

The sites where silver peppermint grows usually have good surface drainage and the parent rock material is mainly mudstone, producing a rather poor soil, which varies from soils with strongly differentiated profiles to nearly skeletal.

This species occurs in open forests, either in pure stands or associated with other eucalypts which include black peppermint (*E. amygdalina*), blue gum (*E. globulus*), manna gum (*E. viminalis*), messmate (*E. obliqua*) and, in one small area, Morrisby's gum (*E. morrisbyi*).

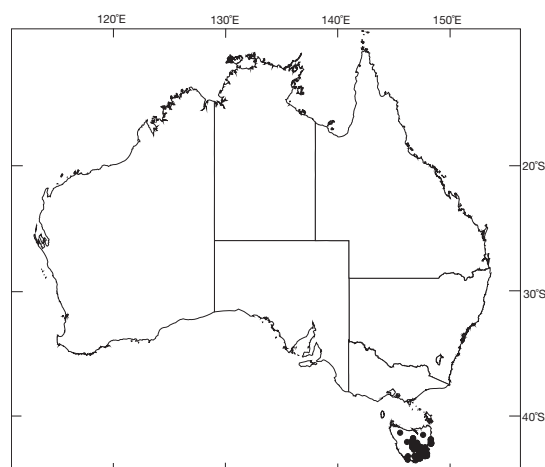
Related species: The peppermints were placed in section *Aromatica*, named because of their strongly scented leaf oils (Brooker 2000). Silver peppermint is closest to Risdon peppermint (*E. risdonii*), which is quite distinctive in its more restricted distribution and by the crown of roundish, connate, pruinose, juvenile leaves. Both species are mostly smooth-barked, a rare feature in the peppermints, but they are easily distinguished from the other smooth-barked Tasmanian peppermint species, white peppermint (*E. pulchella*) which has linear adult leaves making the crown very distinctive in the field.

Publication: *Ned. Kruidk. Arch.* 4, 128 (1856). Type: Near Southampton, C. Stuart 11, cited as 'Van Diemens Land' (Stuart, n. 11, p. 16).

Names: Botanical—Latin *tenuis* (slender), *ramis* (branch). Common—refers to the pruinose and to the peppermint group of eucalypts.

Bark: Decortivating throughout to leave a smooth surface, blotched white to light grey, sometimes with yellowish patches. The stems of young saplings up to about 10 cm diameter often exhibit darkish coloured rings which are conspicuous against the whitish to slightly pruinose young bark. These markings originate from the scars left by the fallen connate juvenile leaves, i.e. their attachment is wholly around the stem.

Leaves: Seedling—opposite, sessile, amplexicaul, later ones often connate, ovate to broad-lanceolate, 3–5 × 2–3 cm, bluish green to bluish, pruinose, the first few pairs often purplish underneath, later pairs concolorous. Juvenile—opposite, sessile, amplexicaul or more commonly connate, broad-ovate or almost orbicular, either rounded at the ends or pointed, 9–15 × 4–8 cm (the pair of leaves together), pruinose, bluish, concolorous. Stems at seedling and juvenile stages are very pruinose and have numerous raised oil glands. Intermediate—alternate, petiolate, broad-lanceolate, 11–14 × 1.6–2.5 cm,



bluish, concolorous. Adult—alternate, petiolate, broad-lanceolate to lanceolate, 5.5–13 × 0.9–2.5 cm, pruinose variable, bluish or quite green (even on the same tree), concolorous.

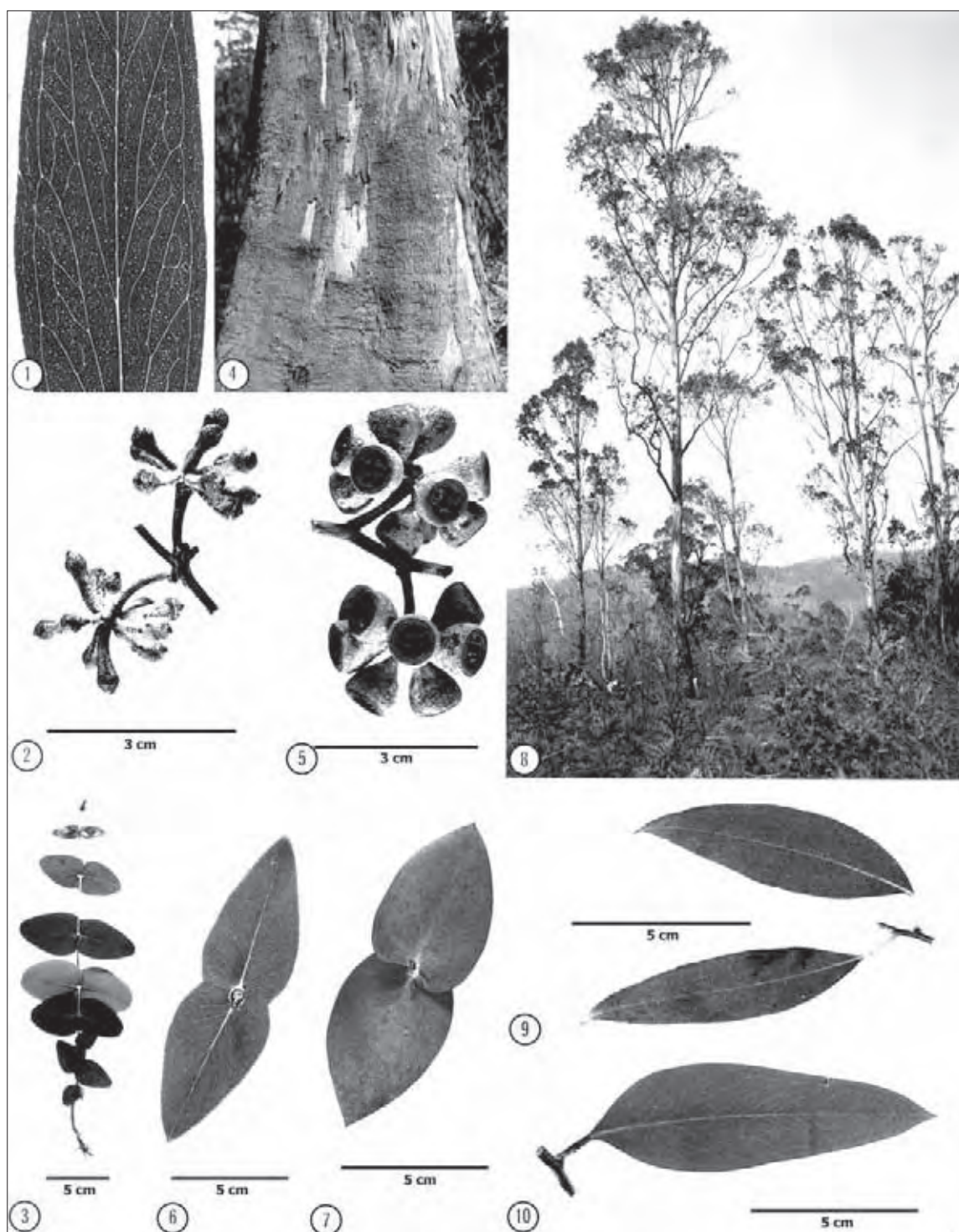
Inflorescences: Simple, axillary, 11 to 15 or more flowered; peduncles terete, 0.6–1.5 cm long; pedicels absent or to 0.5 cm long; buds clavate, pruinose, 0.5–0.7 × 0.3–0.4 cm; opercula hemispherical, sometimes apiculate. Flowers Oct.–Dec.

Fruits: Sessile to pedicellate, obconical or hemispherical, crowded, 0.6–1.1 × 0.6–1.1 cm; disc generally broad, more or less level to descending; valves (3)4, rim level or enclosed, pruinose when new. Seeds pyramidal or obliquely pyramidal, dark brown, hilum terminal.

Wood: Heartwood pale brown, of moderate density; currently has limited use for woodchip export (for pulp), and as firewood.

Climate: Altitudinal range: near sea level to 450 m; Hottest/coldest months: 20–24°C/0–5°C; Frost incidence: low to high (up to about 50 each year and snow at high elevations); Rainfall: 600–1100 mm per year, slight winter max.

Distinctive features: A small to medium-sized tree with numerous buds per inflorescence; bark mostly smooth, connate; extremely pruinose juvenile leaves, buds, young fruits and branchlets; often with pendulous branchlets.



Eucalyptus tenuiramis 1. Adult leaf venation 2. Buds 3. Seedling 4. Bark 5. Fruits 6, 7. Juvenile leaves 8. Stand, north of Native Corners, Tas. 9. Adult leaves 10. Intermediate leaf

White Peppermint

Eucalyptus pulchella Desf.

White peppermint is a small to medium-sized tree 9–21 m high and with dbh up to 0.8 m. The trunks of open-growing specimens may divide at less than one-quarter of the tree height, but in forest formation they may extend to three-quarters tree height. The very fine ultimate branchlets and twigs, and the very narrow, pendulous adult leaves give this species a graceful appearance.

White peppermint is a fairly common eucalypt of the lower country of south-eastern Tasmania where it is endemic, extending no farther north than Bothwell, Oatlands and Swansea. It also occurs on the Tasman Peninsula and to about 50 km south of Hobart.

White peppermint is a tree occurring on hilly to undulating terrain, usually with good surface drainage, but the sites vary from somewhat poor, rounded ridge tops to the more fertile, lower slopes of small valleys. In the first situation the soils may be almost skeletal, but in the latter they are usually deep dermosols (yellow podzolics). This species is restricted to dolerite-derived soils. Where there is a juxtaposition with sedimentary rocks there is a notable and sudden change of species.

White peppermint occurs in open forests often associated with manna gum (*E. viminalis*), swamp gum (*E. ovata*), Tasmanian blue gum (*E. globulus*), messmate (*E. obliqua*) and silver wattle (*Acacia dealbata*).

Related species: The peppermints belong in section *Aromatica*, named because of their strongly scented leaf oils (Brooker 2000). White peppermint is one of the three mostly smooth-barked peppermints, but is easily distinguished from the closely related silver peppermint (*E. tenuiramis*) and Risdon's peppermint (*E. risdonii*) by its crown of linear adult leaves.

Publication: *Cat. Hort. Paris* Ed. 3, 408 (1829). Type: New Holland, 1792, J. de Labillardière.

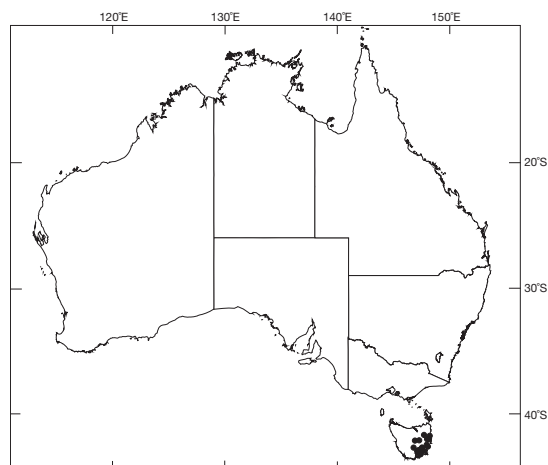
Names: Botanical—Latin *pulchellus* (beautiful and little), presumably of the leaves and canopy. Common—refers to the bark and to the peppermint group of eucalypts.

Bark: Decortivating nearly to ground level in short strips or elongated plates, to leave a smooth surface which is at first yellow, weathering to white, or white with bluish streaks, or mottled very light grey. Some grey, subfibrous bark may be retained at the base of large trees.

Leaves: Seedling—opposite and sessile for 5–8 pairs, later ones slightly alternate and shortly petiolate, lanceolate to linear, 4–7 × 0.3–1.1 cm, green, slightly discolorous. Juvenile—alternate, shortly petiolate, linear, 5–10 × 0.3–0.7 cm, green, concolorous. Intermediate—alternate, petiolate, lanceolate to linear, 8–14 × 0.4–1 cm, green, concolorous. Adult—alternate, petiolate, linear, 5–10 × 0.2–0.7 cm, green, concolorous.

Inflorescences: Simple, axillary, more than 15-flowered; peduncles angular, 0.3–0.8 cm long; pedicels 0.1–0.3 cm long; buds clavate, 0.3–0.5 × 0.2–0.3 cm, opercula hemispherical. Flowers Jun.–Jul.

Fruits: Shortly to distinctly pedicellate, cupular to truncate-globose, crowded, 0.5–0.6 × 0.5–0.7 cm; disc relatively broad, more or less level to slightly descending; valves 4, about rim

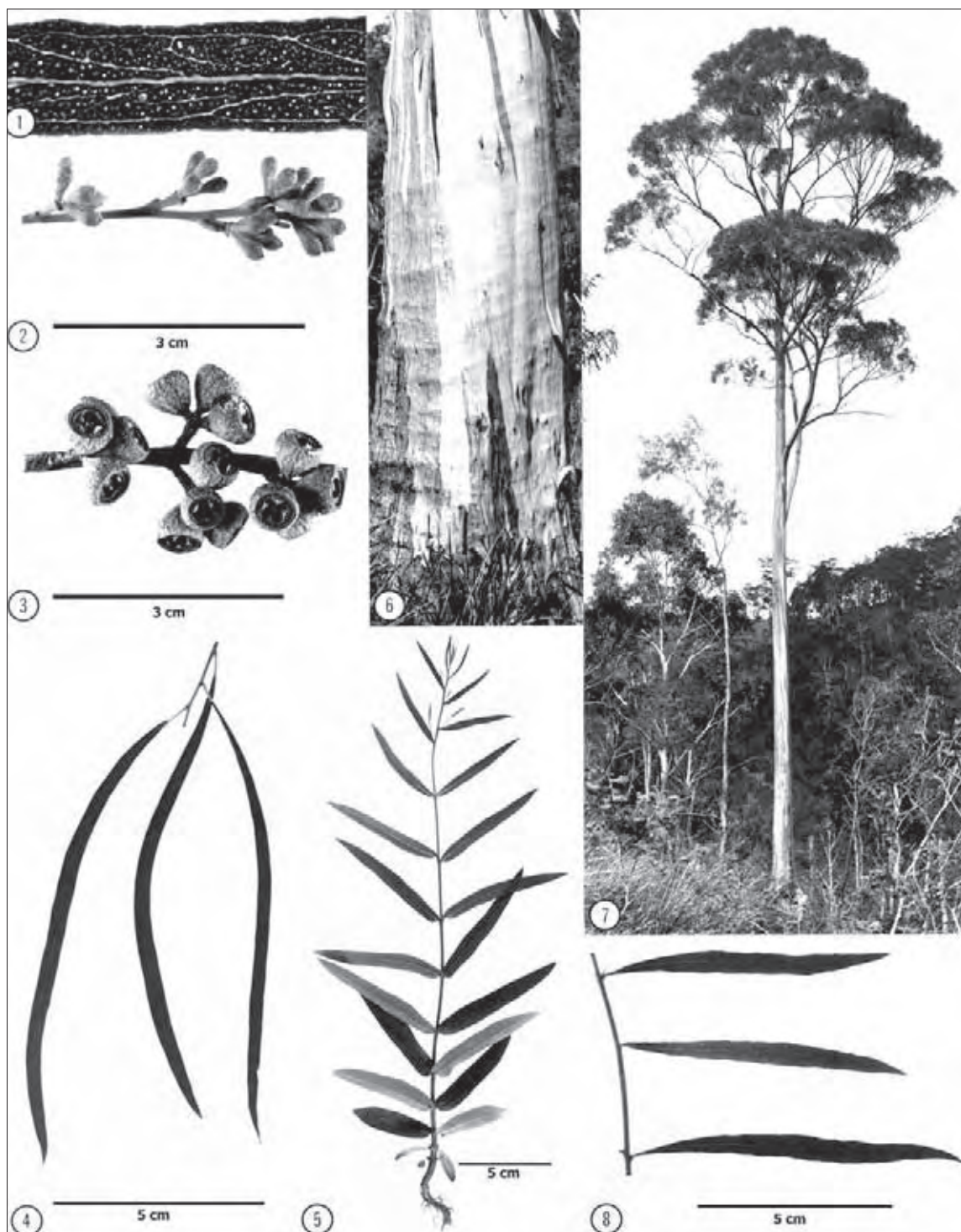


level. Seeds pyramidal or obliquely pyramidal, brown to red-brown, hilum terminal.

Wood: Heartwood light brown, of moderately high density; currently used for woodchip export (for pulp) and firewood.

Climate: Altitudinal range: 150–450 m; Hottest/coldest months: 20–24°C/0–5°C; Frost incidence: moderate to high (up to 50 each year and some snow at high elevations); Rainfall: 500–1000 mm per year, slight winter max.

Distinctive features: A gum-barked tree with very narrow adult leaves producing a willowy canopy; axillary, many-flowered inflorescences; small clavate buds and small, crowded fruits with moderately broad, reddish disc.



Eucalyptus pulchella 1. Adult leaf venation 2. Buds 3. Fruits 4. Adult leaves 5. Seedling 6. Bark 7. Tree, north of Sorell, Tas. 8. Juvenile leaves

Black Peppermint

Eucalyptus amygdalina Labill.

Black peppermint is a medium-sized to occasionally tall tree, usually in the height range 15–30 m with dbh up to 1 m, but on poor soils it may be reduced to less than 10 m and is occasionally of mallee form. The mature crown of narrow adult leaves is distinctive.

Black peppermint is endemic to Tasmania and is found scattered throughout most of the eastern half of the island, except for the high country in the north-east and the high central plateau. It occurs along the coastal area from near Burnie in the north-west to the eastern part of the island and down the east coast as far as the Huon River area, and South Bruny Island. Inland it extends through the relative lowlands from Launceston to Oatlands and the Tasman Peninsula.

This species grows on a wide range of topography, from gentle lowlands to moderately steep hills and mountainsides. Typically the soils are poor, often siliceous and acidic. Parent material varies and includes sandstones, mudstones, conglomerates, dolerite, quartzites and granites.

Black peppermint grows in open eucalypt forests often associated with silver peppermint (*E. tenuiramis*), silver-top ash (*E. sieberi*), candlebark (*E. rubida*) and sometimes with mountain gum (*E. dalrympleana*) and manna gum (*E. viminalis*). In the same general area swamp gum (*E. ovata*) usually occupies wetter soil types while Tasmanian blue gum (*E. globulus*), messmate (*E. obliqua*) and even mountain ash (*E. regnans*) occur on the better quality sites.

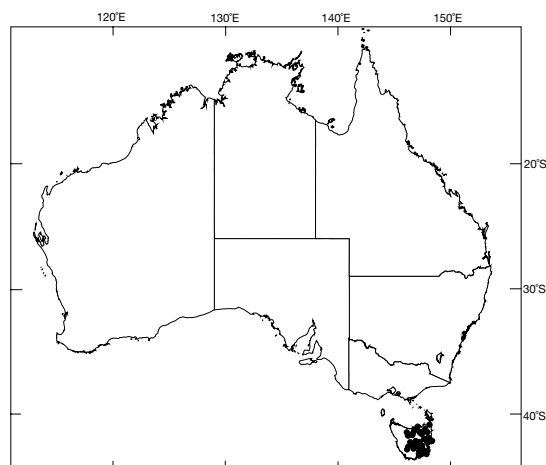
Related species: The peppermints belong in section *Aromatica* named because of their strongly scented leaf oils (Brooker 2000). Black peppermint is morphologically intermediate between white peppermint (*E. pulchella*), which is mostly smooth-barked and narrower-leaved, and Smithton peppermint (*E. nitida*), which is rough-barked as a tree and is broader-leaved and varies from a mallee to a tall tree.

Publication: *Nov. Holl. Pl. Spec.* 2, 14 (1806). Type: 'in capite Van Diemen', 1792, J. Labillardière.

Names: Botanical—Latin *amygdala* (almond), allusion obscure. Common—presumably distinguishes this species from white peppermint (*E. pulchella*) which has a largely smooth, white bark.

Bark: Rough and persistent on the trunk and larger branches, peppermint type, finely fibrous, thin, compact, longitudinally fissured; smooth bark of smaller limbs, salmon pink or yellow bleaching to white or grey. The mallee form has smooth, yellowish bark with grey patches.

Leaves: Seedling—opposite, sessile, amplexicaul, ovate to broad-lanceolate, 4–7 × 1–2.2 cm, green to lightly bluish green, discolorous. Juvenile—becoming alternate and petiolate, broad-lanceolate to lanceolate, 6.5–10 × 0.8–1.6 cm, green to slightly bluish green, slightly discolorous. Intermediate—alternate, petiolate, lanceolate to narrow-lanceolate, 12–15 × 1–1.7 cm, green, concolorous. Adult—



alternate, petiolate, narrow-lanceolate to linear or falcate; 7–12 × 0.5–1.3 cm, dull to slightly glossy, green, concolorous.

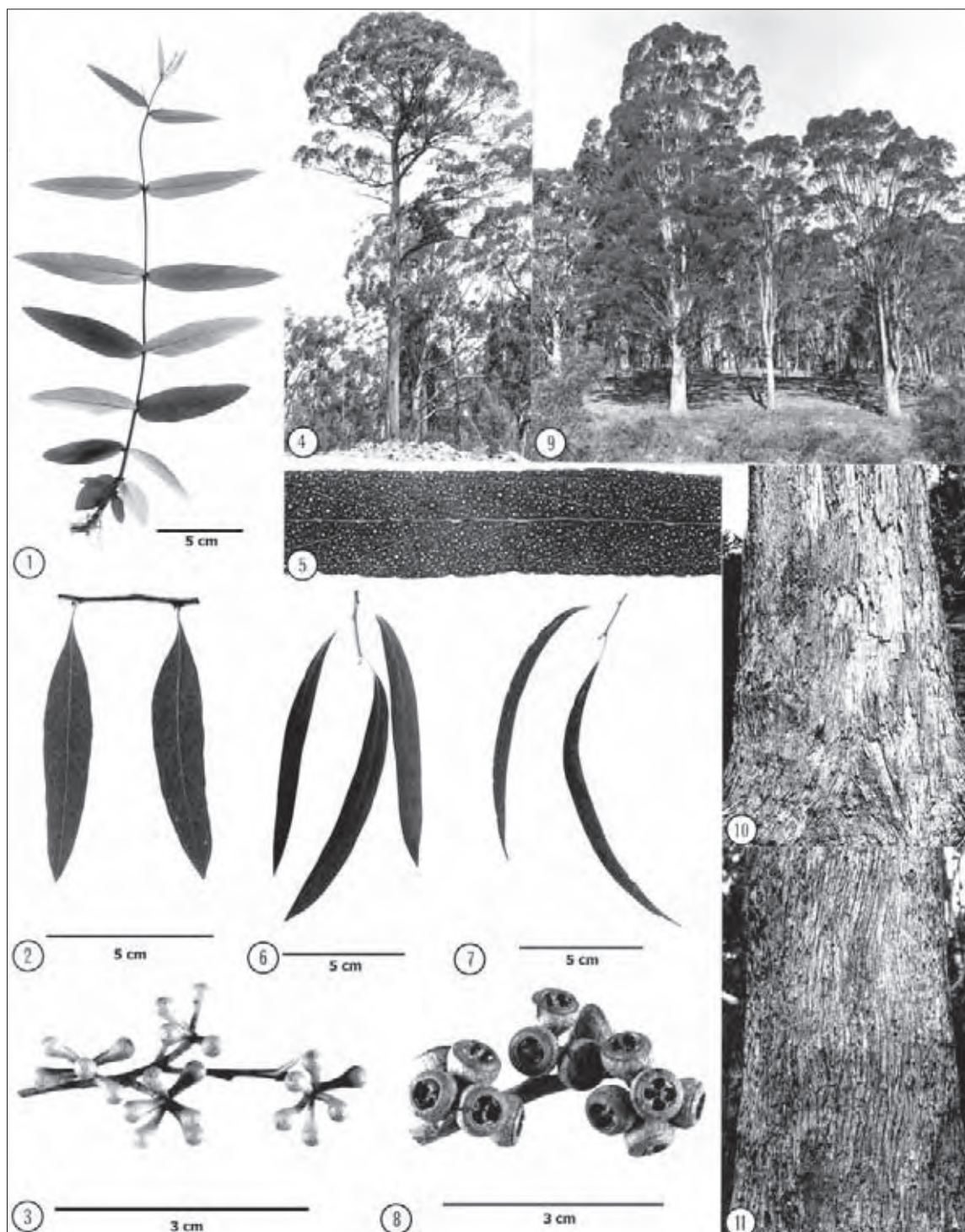
Inflorescences: Simple, axillary, 11 to 15 or more flowered; peduncles terete to angular, 0.4–1 cm long; pedicels 0.1–0.3 cm long; buds clavate, 0.4–0.5 × 0.25–0.3 cm, opercula hemispherical-apiculate. Flowers Nov.–Jan.

Fruits: Pedicellate, cupular to almost hemispherical, crowded, 0.4–0.7 × 0.5–0.7 cm; disc relatively broad, more or less level; valves 4, about rim level. Seeds pyramidal or obliquely pyramidal, brown, hilum terminal.

Wood: Heartwood pale brown, fairly hard and tough, of moderate strength and durability; density about 690 kg m⁻³; used for light construction, joinery, fence posts and fuel.

Climate: Altitudinal range: near sea level to 750 m; Hottest/coldest months: 18–23°C/0–6°C; Frost incidence: moderate to high (up to 90 each year and snow at high elevations); Rainfall: 700–2400 mm per year, winter-spring max.

Distinctive features: Medium-sized to occasionally tall tree; thin peppermint bark persistent usually to the larger branches; adult leaves with very acute venation; fruits cupular to almost hemispherical, crowded.



Eucalyptus amygdalina 1. Seedling 2. Juvenile leaves 3. Buds 4. Tree, north-west of Little Swanport, Tas.
5. Adult leaf venation 6. Intermediate leaves 7. Adult leaves 8. Fruits 9. Stand, south of Boswell, Tas.
10, 11. Bark

Smithton Peppermint Peppermint (Tas.)

Eucalyptus nitida Hook. f.

Smithton peppermint is a very variable species in height and habit, varying from a mallee or small tree to a tall tree up to 40 m in height under optimum conditions, with a dbh of 1 m. On poor coastal sands or under other adverse conditions such as at high altitudes, it may be reduced to a small, bushy habit with a short trunk of poor form. The tall tree form grows only in Tasmania and smaller forms occur elsewhere in Tasmania and on the Bass Strait islands.

Smithton peppermint has a widespread occurrence in western, north-western and southern Tasmania, and the eastern Bass Strait islands.

This species grows in varied topography from small flats near sea level to undulating, hilly and plateau country at higher altitudes. Soils may be infertile sands and of an acidic nature in coastal sites which support the mallee form. The best development of *E. nitida* is in the low hills south of Smithton in the north-west of Tasmania where it grows on well-drained, deep, relatively fertile loams.

Smithton peppermint grows in woodlands, open forests or tall open forests. On adverse lowland sites it may occur in pure stands; elsewhere it grows as a component in mixture with several other eucalypts, including manna gum (*E. viminalis*), alpine ash (*E. delegatensis*), messmate (*E. obliqua*) and yellow gum (*E. subcrenulata*). On Flinders Island it may grow with Tasmanian blue gum (*E. globulus*). Large trees of excellent form also occur in rainforest situations in the Huon River Valley where associates include myrtle beech (*Nothofagus cunninghamii*).

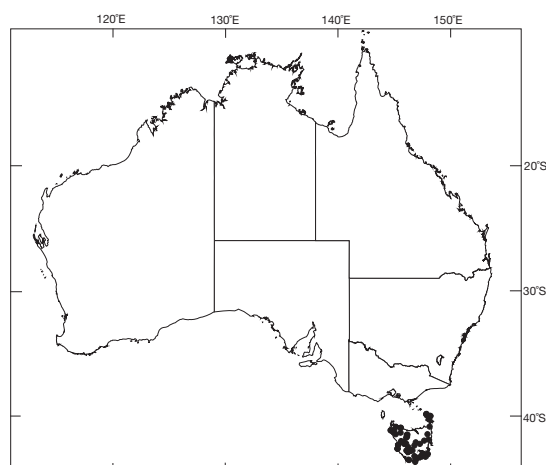
Related species: The peppermints belong in section *Aromatica*, named because of their strongly scented leaf oils (Brooker 2000). Smithton peppermint resembles black peppermint (*E. amygdalina*) in the rough bark, but is distinguished by the broader adult leaves. However, some intergradation between the two may be apparent where their distributions overlap. Smithton peppermint is never pruinose which distinguishes it from other Tasmanian peppermints such as silver peppermint (*E. tenuiramis*) and Risdon peppermint (*E. risdonii*). Mainland peppermints in southern Victoria and south-eastern South Australia were once included in Smithton peppermint, but these are now recognised to be a separate species, shining peppermint (*E. willisii*), which differs in the smaller juvenile leaves and slightly smaller fruits.

Publication: *Fl. Tasman.* 1, 137 (1856). Type: Circular Head ('Sisters'), Tasmania, 21 Jan. 1837, R.C. Gunn 808.

Names: Botanical—Latin *nitidus* (shining), presumably of the leaves. Common—after the town of Smithton.

Bark: Rough and persistent only at the base or for about half to three-quarters of the trunk, short-fibred, tight, with narrow longitudinal fissures, decorticating from the branches in long ribbons; smooth bark yellow-green, weathering to whitish grey then dark grey.

Leaves: Seedling—opposite, sessile, elliptical to ovate or broad-lanceolate, 4.5–8.5 × 2.2–5 cm, bluish green or greyish green, discolorous. Juvenile—becoming alternate and



petiolate, ovate to broad-lanceolate, 6–11 × 2.8–7 cm, greyish green, slightly discolorous at first then becoming concolorous. Stems have numerous raised oil glands at the seedling and juvenile stages. Intermediate—alternate, petiolate, broad-lanceolate, 8.5–15 × 1.7–3 cm, green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 6.5–13 × 0.8–1.7 cm, green, concolorous.

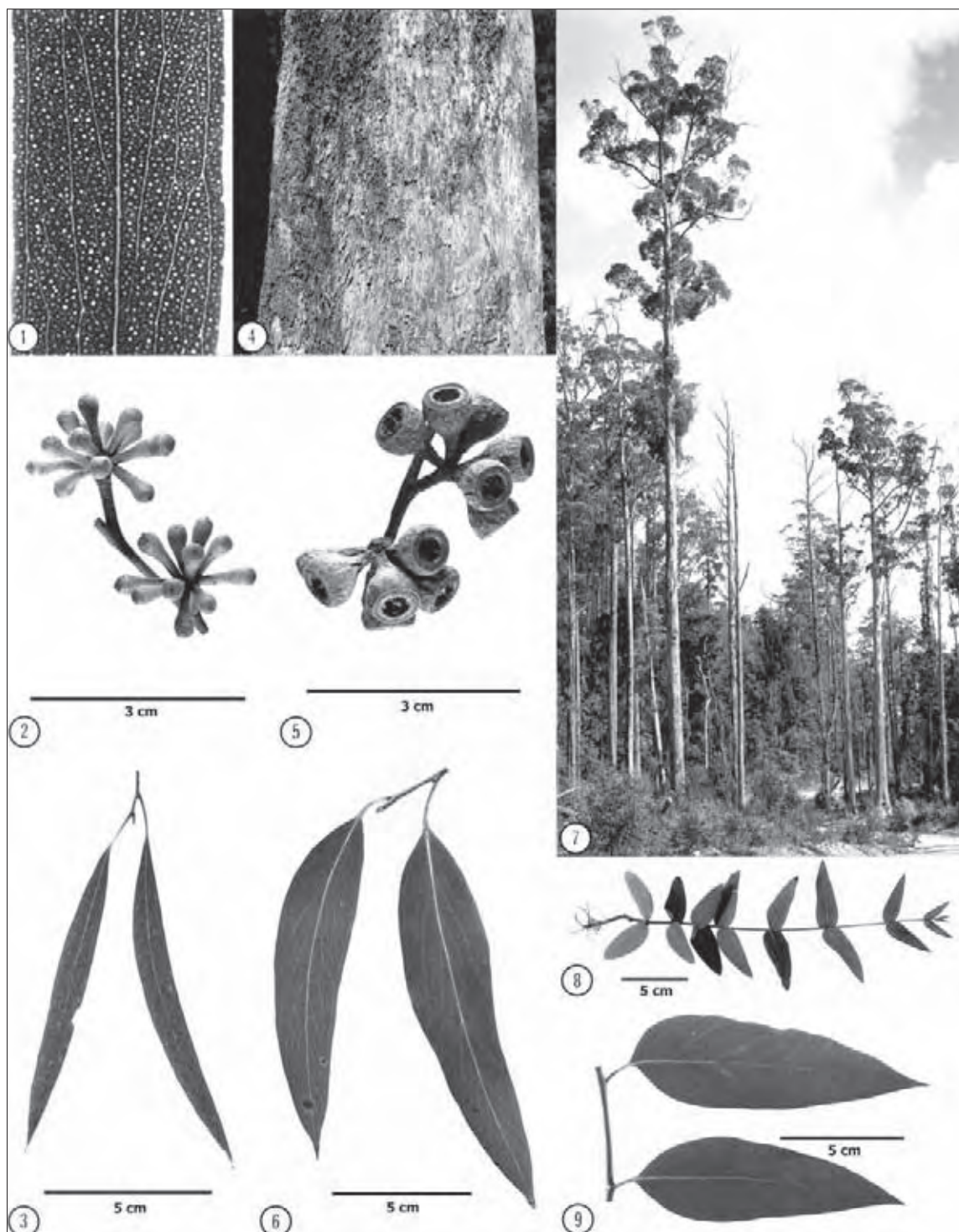
Inflorescences: Simple, axillary, 11 or more flowered; peduncles more or less terete or slightly angular, 0.2–0.8 cm long; pedicels absent or up to 0.4 cm long; buds clavate, 0.5–0.6 × 0.3 cm, opercula hemispherical, often apiculate. Flowers Dec.–Jan.

Fruits: Sessile or shortly pedicellate, hemispherical to obconical, crowded, 0.4–0.8 × 0.5–0.9 cm, disc broad, more or less level or slightly ascending; valves 3–5, about rim level. Seeds pyramidal or obliquely pyramidal, brown, hilum terminal.

Wood: Heartwood pale, of moderate density and strength, but somewhat low durability; kino (gum) veins present; density about 980 kg m⁻³; used for light building construction. Wood appearance similar to messmate (*E. obliqua*).

Climate: Altitudinal range: near sea level to 450 m; Hottest/coldest months: 19–22°C/2–8°C; Frost incidence: low to moderate (up to 30 each year and snow at high elevations); Rainfall: 700–2500 mm per year, winter–spring max.

Distinctive features: A partly rough-barked small or tall tree or mallee; adult leaf venation very acute; many-flowered; fruits crowded, often persisting on older branchlets.



Eucalyptus nitida 1. Adult leaf venation 2. Buds 3. Adult leaves 4. Bark 5. Fruits 6. Intermediate leaves 7. Stand, near Smithton, Tas. 8. Seedling 9. Juvenile leaves

Narrow-leaved Peppermint Peppermint

Eucalyptus radiata Sieber ex DC.

Narrow-leaved peppermint varies in size from a bushy tree 10–15 m tall to a medium-sized to tall tree of moderately good form 20–30 m tall and a dbh up to 1 m, or a tall forest tree up to 50 m in height and 1.5 m dbh. Growing in open conditions the smaller trees often retain foliage to near ground level. Crowns are often conspicuously densely foliated. There are three subspecies, the typical, subsp. *robertsonii* (treated separately see page 602) and subsp. *sejuncta*.

Subsp. *radiata* occurs in southern Victoria from Wombat State Forest, the Otway Ranges and south Gippsland north-eastwards through the Southern Tablelands of New South Wales to about east of Rylstone. In Tasmania it occurs in the upper Wilmut, Mersey and Forth Rivers areas. Subsp. *sejuncta* occurs in the Barrington Tops region of New South Wales, north along the Northern Tablelands to the Queensland–New South Wales border.

These peppermints occur largely on tablelands where they prefer hill and mountain slopes, especially the more sheltered aspects, and broad valleys. Low altitude near-coastal occurrences are known in Victoria. They grow on a wide range of soil types including sands, skeletal soils, volcanic loams and weakly differentiated reddish loams derived from a range of parent materials such as shales and granite.

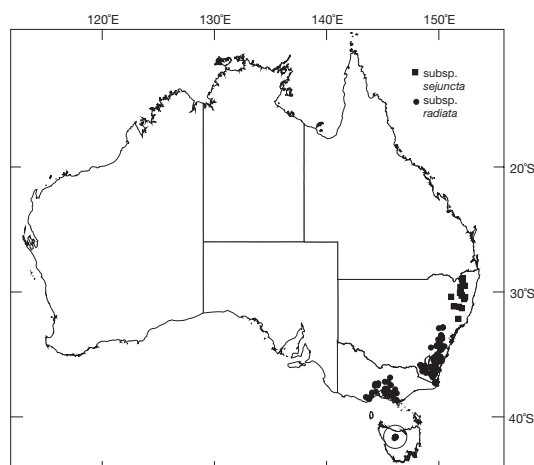
They usually occur in open or tall open eucalypt forests with species such as manna gum (*E. viminalis*), peppermints (*E. dives*, *E. elata*), swamp gum (*E. ovata*), Sydney peppermint (*E. piperita*), New England blackbutt (*E. andrewsii*), stringybarks (*E. laevopinea*, *E. macro-rhyncha*), messmate (*E. obliqua*), silvertop ash (*E. sieberi*), mountain gum (*E. dalrympleana*), snow gum (*E. pauciflora*), candlebark (*E. rubida*) and blackwood (*Acacia melanoxylon*).

Related species: The peppermints belong in section *Aromatica* (Brooker 2000). Narrow-leaved peppermint is one of the mainland peppermints that occur widely in New South Wales and Victoria. It should not be confused with the other widespread peppermint, broad-leaved peppermint (*E. dives*), which differs by the conspicuous large, broad, bluish green juvenile leaves and broader adult leaves.

Publication: Subsp. *radiata*: Prod. 3, 218 (1828). Type: New Holland, 1823, F.W. Sieber 475. Subsp. *sejuncta* L.A.S. Johnson & K.D. Hill: *Telopea* 4, 98 (1990). Type: Aberfoyle Road, Guyra, Dec. 1932, E.N. McKie.

Names: Botanical—Latin *radiatus* (radiate), referring to the radiate arrangement of the buds in the inflorescence; Latin *sejunctus* (separated), refers to its distribution from the other subspecies. Common—refers to the narrower leaves compared with *E. dives*.

Bark: Persistent on the trunk and larger branches, peppermint-type, finely subfibrous with shallow longitudinal fissures, grey or brownish; upper branches smooth, whitish or greyish.



Leaves: Seedling—opposite, sessile, amplexicaul or base rounded, lanceolate, 5.5–10 × 1.4–3.2 cm, green discolorous. Juvenile—opposite, sessile, later ones alternate, petiolate, broad-lanceolate to narrow-lanceolate, 8–18 × 1.5–4.5 cm, green, discolorous. Stems at seedling and juvenile stage have many raised oil glands. Intermediate—alternate, petiolate, lanceolate to narrow-lanceolate, 13–18 × 1.5–2.5 cm, green or broad-lanceolate, 9.5–19 × 1.5–4 cm, concolorous. Adult—alternate, petiolate, narrow-lanceolate to almost linear, 7–15 × 0.7–1.5 cm, green (*radiata*) or lanceolate to falcate, 5.5–18 × 1–2.5 cm, usually glossy green (*sejuncta*), concolorous, thin, but firm.

Inflorescences: Simple, axillary, 11 to more than 20-flowered; peduncles more or less terete, 0.2–0.8 cm long; pedicels 0.1–0.5 cm long; buds clavate, 0.3–0.5 × 0.2–0.3 cm, opercula low conical or hemispherical-apiculate. Flowers Oct.–Jan.

Fruits: Pedicellate, more or less hemispherical to truncate-globose, 0.3–0.7 × 0.4–0.7 cm; disc relatively broad, more or less level; valves 3–5, generally enclosed or to near rim level, sometimes slightly exserted. Seeds pyramidal or obliquely pyramidal, black, brown or red-brown, hilum terminal.

Wood: Sapwood sometimes susceptible to attack by *Lyctus* borers; heartwood light brown, moderately coarse-textured, generally straight-grained, kino (gum) veins common, shrinkage on seasoning rather high, moderately durable, density 625–852 kg m⁻³; used for general construction.

Climate: Altitudinal range: 50–1200 m (*radiata*), 800–1350 (*sejuncta*); Hottest/coldest months: 23–27°C/–1–5°C (*radiata*), 23–26°C/–1–0°C (*sejuncta*); Frost incidence: low to high, up to 70 each year (*radiata*), high, up to 100 each year (*sejuncta*); Rainfall: 650–1100 mm per year, uniform to summer max. (*radiata*), 800–900 mm per year, summer max. (*sejuncta*).

Distinctive features: A small to tall tree with fine, peppermint-type bark to large limbs; juvenile leaves opposite, sessile and amplexicaul for many pairs; adult leaves thin, with strong peppermint smell when crushed; 11 to more than 20 buds per unit inflorescence.



Eucalyptus radiata subsp. *radiata* 1. Bark 2. Adult leaf venation 3. Seedling 4. Juvenile leaf 5. Adult leaves 6. Buds 7. Stand, between Black Springs and Taralga, N.S.W. 8. Intermediate leaves 9. Fruits

Narrow-leaved Peppermint

Eucalyptus radiata subsp. *robertsonii* (Blakely) L.A.S. Johnson & Blaxell

This form of narrow-leaved peppermint is mainly a medium-sized to tall forest tree, up to 50 m in height and 1.5 m dbh. The trunk is usually straight with typical peppermint-type bark which is often partially covered with various species of lichen. The crown is usually very dense for a eucalypt and consists of numerous narrow, dull-green or bluish green leaves.

Subsp. *robertsonii* has a more restricted inland distribution than the closely allied *E. radiata* subsp. *radiata* and occurs at higher elevations near Canberra and along the western side of the Southern Tablelands of New South Wales. It is particularly common between Orange and Oberon and in the Tumut district. Intergrades between the two subspecies occur in the Bombala district.

This taxon grows on a wide range of soils, and in mountainous areas these are mainly skeletal, sometimes with a dark brown loamy surface. On more gentle slopes the surface soil is brown loam to clay loam over heavy loam or clay. Other soils include weakly differentiated reddish loams derived from shales and granitic parent materials. The species prefers hill and mountain slopes, especially the more sheltered aspects, and broad valleys.

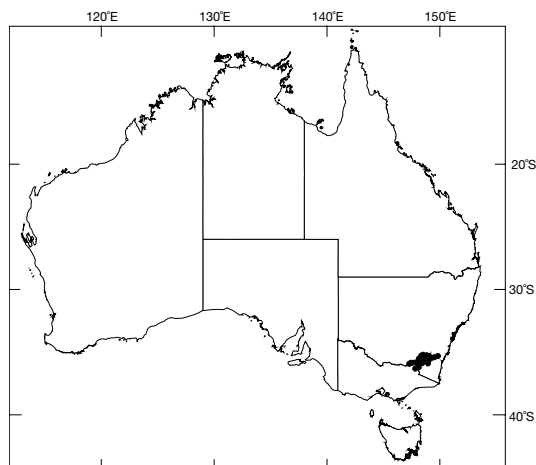
Subsp. *robertsonii* occurs in open forests or tall open forests. Associated eucalypts include mountain gum (*E. dalrympleana*), broad-leaved peppermint (*E. dives*), manna gum (*E. viminalis*), snow gum (*E. pauciflora*), candlebark (*E. rubida*), red stringybark (*E. macrorhyncha*) and blackwood (*Acacia melanoxylon*).

Related species: The peppermints belong in section *Aromatica*, named because of their strongly scented leaf oils (Brooker 2000). The narrow-leaved peppermints should not be confused with the other widespread peppermint, broad-leaved peppermint (*E. dives*), which differs by the conspicuous large, broad, bluish green juvenile leaves and broader adult leaves. Subsp. *robertsonii* differs from subsp. *radiata* and subsp. *sejuncta* in having broader seedling, juvenile, intermediate and adult leaves, a dull, grey-green to blue-green crown and pruinose buds. Gippsland peppermint (*E. croajingolensis*), a low altitude peppermint from the far South Coast of New South Wales and eastern Victoria, may be confused with subsp. *robertsonii* but differs by the broader juvenile and adult leaves and the often pendulous branchlets.

Publication: *Contr. N.S.W. Natl Herb.* 4, 380–381 (1973). Type: Talbingo Mountain, near Tumut, Sept. 1924, C.C. Robertson and W. A.W. de Beuzeville.

Name: Botanical—*radiata*, Latin *radiatus* (radiate), referring to the radiate arrangement of the buds in the inflorescence; *robertsonii*, after C.C. Robertson (1880–1946), a South African forester who visited Australia and collected a type of this taxon. Common—alludes to the distinctions of the narrower adult leaves of this species compared to the broad-leaved peppermint (*E. dives*).

Bark: Peppermint-type, persistent, closely fibrous over the trunk and branches, dark grey or brown, small branches smooth, whitish.



Leaves: Seedling—opposite for many pairs, sessile, amplexicaul, lanceolate to broad-lanceolate, 5–9 × 1.5–3 cm, greyish green, discolorous. Juvenile—opposite and sessile at first, later ones alternate, petiolate, lanceolate to broad-lanceolate, 8–10 × 2.5–4 cm, greyish green, discolorous. There are numerous raised oil glands on the stems in the seedling and juvenile stages. Intermediate—alternate, petiolate, broad-lanceolate, 9.5–19 × 1.5–4 cm, greyish green, concolorous. Adult—alternate, petiolate, lanceolate to narrow-lanceolate, 7.5–13 × 0.8–1.5 cm, greyish green to subpruinose, concolorous.

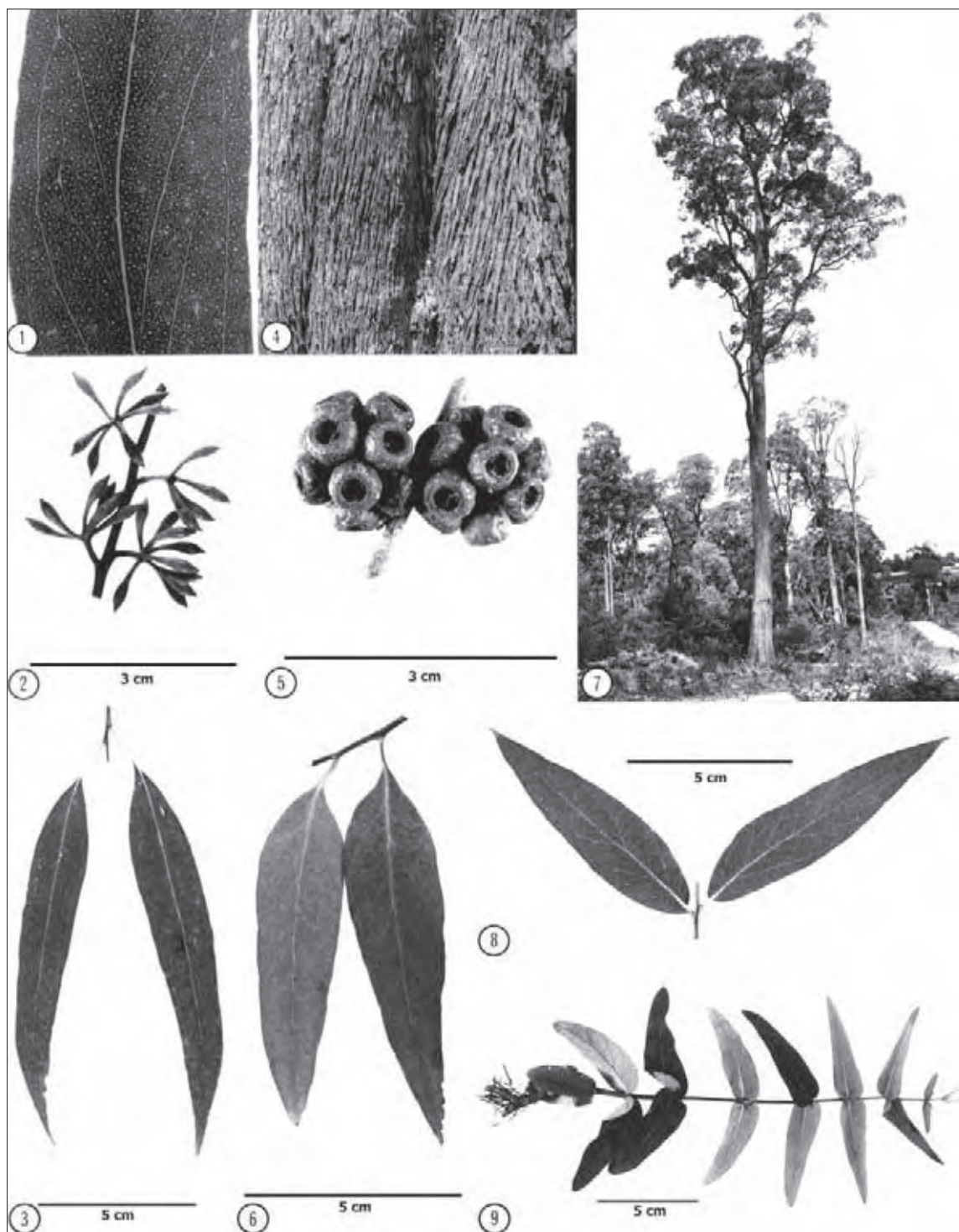
Inflorescences: Simple, axillary, 15- or more flowered; peduncles terete, 0.5–0.8 cm long; pedicels 0.1–0.3 cm long; buds clavate, 0.3–0.4 × 0.2 cm, often pruinose; opercula conical to hemispherical-apiculate. Flowers Feb.–Mar.

Fruits: Shortly pedicellate, truncate-globose, 0.4–0.5 × 0.4–0.5 cm; disc relatively broad, more or less level or occasionally descending; valves 3 or 4, to rim level or enclosed.

Wood: Sapwood fairly wide, sometimes susceptible to attack by *Lyctus* borers; heartwood light brown, sometimes with a pink tinge, moderately hard and strong, moderately durable, fissile, kino (gum) veins common, generally straight-grained, has a rather high shrinkage rate; density about 720 kg m⁻³; used for general construction where the shrinkage can be tolerated, while better quality logs may produce joinery material.

Climate: Altitudinal range: 200–1200m; Hottest/coldest months: 23–30°C/–4–2°C; Frost incidence: high, up to 100 each year; Rainfall: 800–1400 mm per year, uniform or with a slight winter maximum.

Distinctive features: Medium-sized to tall forest tree with peppermint-type bark; large numbers of buds (often pruinose) per inflorescence; sessile, amplexicaul juvenile leaves; canopies with a faintly pruinose appearance.



Eucalyptus radiata subsp. *robertsonii* 1. Adult leaf venation 2. Buds 3. Adult leaves 4. Bark 5. Fruits 6. Intermediate leaves 7. Tree, between Batlow and Tumbarumba, N.S.W. 8. Juvenile leaves 9. Seedling

River Peppermint River White Gum

Eucalyptus elata Dehnh.

River peppermint is usually an attractive tree of good form around 20–30 m tall and 0.5–1 m dbh. Under optimum conditions it may attain 45 m in height and 1.5 m dbh.

River peppermint occurs mainly in the lowland coastal regions and adjacent hills of south-eastern Australia from around Putty in New South Wales to the Gippsland district of Victoria, where it occurs mainly from east of Bairnsdale, with outliers near Heyfield and east of Mt Useful. It also extends to the eastern side of the Central and Southern Tablelands areas of New South Wales.

Best growth is on moderately fertile, alluvial loams, which are likely to be moist in the subsoil at all times, but not waterlogged. These soils may be derived from a variety of rock types, including slates, sandstones and igneous material. The species typically grows in narrow belts along watercourses and in small valleys, but also extends to undulating topography where it is smaller and of poorer form.

River peppermint occurs in open or tall open eucalypt forests often associated with woollybutt (*E. longifolia*), manna gum (*E. viminalis*), narrow-leaved peppermint (*E. radiata*), gully gum (*E. smithii*) and swamp gum (*E. ovata*).

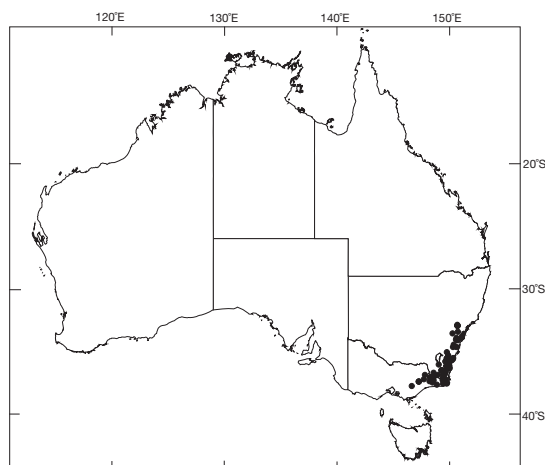
Related species: The peppermints belong in the section *Aromatica*, named because of their strongly scented leaf oils (Brooker 2000). River peppermint is somewhat distanced from the more typical peppermints because of the hard, compacted bark over the lower part of the trunk only, and the very large number of buds per inflorescence. Because of its erect forest tree habit, moist habitat and bark type including the conspicuous ribboning, it should not be confused with other related species, but it does resemble the unrelated gully gum (*E. smithii*) and Big Badja gum (*E. badjensis*) of subgenus *Symphyomyrtus*, which may be co-occurring, as they share similar habit, bark and narrow adult leaves. Close inspection of the inflorescence clearly distinguishes these species, as they are strictly 7-budded and 3-budded respectively. Rare forms of river peppermint occur above Little River Gorge in far eastern Victoria where the species is reduced to a smooth-barked mallee.

Publication: *Cat. Plant. Hort. Camald.* 1, 28 (1829). Type: Hortus Camaldulensis, Italy (cultivated), F. Dehnhardt.

Names: Botanical—Latin *elatus* (tall). Common—refers to habitat and to the peppermint group of eucalypts.

Bark: Persistent, grey to almost black, subfibrous maturing to hard and compacted, longitudinally fissured for up to 10 m or so, decorticating in long ribbons above which may be held in the crown to leave a smooth greyish white to white surface.

Leaves: Seedling—opposite, sessile, amplexicaul, lanceolate, 3.5–7 × 1.2–2 cm, green, discolorous. Juvenile —opposite, sessile, amplexicaul, lanceolate, 8–12 × 2–3 cm, green, discolorous. Stems of seedling and juvenile stages have many prominent raised oil glands. Intermediate—alternate, petiolate, lanceolate, 12–22 × 1.1–2.1 cm, green, concolorous.



Adult—alternate, petiolate, narrow-lanceolate, 10–14 × 0.7–1.3 cm, green, concolorous.

Inflorescences: Simple, axillary, many-flowered (often more than 20 and up to about 40); peduncles angular, 0.5–1 cm long; pedicels 0.2–0.5 cm long; buds clavate, 0.4–0.5 × 0.2–0.25 cm; opercula hemispherical, usually apiculate, or conical. Flowers Sept.–Nov.

Fruits: Pedicellate, hemispherical, ovoid or globular to truncate-globose, 0.4–0.6 × 0.4–0.6 cm; disc relatively broad, more or less level or descending (sometimes vertically); valves 3 or 4, slightly enclosed. Seeds pyramidal or obliquely pyramidal, black, brown or red-brown, hilum terminal.

Wood: Heartwood pale brown, subject to kino (gum) veins, fissile, works well, not durable in the ground; density not known; can be used for light construction and for interior finish and joinery.

Climate: Altitudinal range: near sea level to 750 m; Hottest/coldest months: 24–27°C/0–5°C; Frost incidence: low to high (up to 50 each year and snow at high elevations); Rainfall: 650–1700 mm per year, uniform.

Distinctive features: Bark on lower part of trunk compact, grey to almost black, smooth white above with long hanging ribbons of partly decorticated bark; adult leaves narrow, with numerous oil glands and strong eucalyptus smell on crushing; axillary, many-flowered inflorescences (often between 20 and 40 buds on each peduncle).



Eucalyptus elata 1. Lower bark, mature tree 2. Adult leaf venation 3. Seedling 4. Juvenile leaves 5. Intermediate leaves 6. Adult leaves 7. Lower bark, young tree 8. Buds 9. Tree, south of Moruya, N.S.W. 10. Fruits

Broad-leaved Peppermint Peppermint, Blue Peppermint (Vic.)

Eucalyptus dives Schauer

Broad-leaved peppermint is usually a medium-sized tree, 12–25 m in height and up to 0.7 m dbh, though on poor, dry sites it may be smaller. The trunk is from one-quarter to one-third of the total height and, on open sites, branches are retained almost to ground level. The crown is large, with many branches and drooping branchlets.

Broad-leaved peppermint is widespread in central and eastern Victoria, in the east especially on the hills and foothills of the Great Dividing Range. In New South Wales it is common south from Niangula, on the south-western slopes and on the Southern Tablelands.

This species occurs on a wide range of sites from the edges of plains to plateaux and the foothills of mountain ranges, particularly on drier northerly aspects. It is commonly found on rather poor, shallow and stony soils of lower fertility than those favoured by narrow-leaved peppermint (*E. radiata*), although the two species grow together in some places. It occurs on a wide range of rock substrates, particularly metasedimentary types.

Broad-leaved peppermint usually occurs in open forests or woodlands where it may be a dominant species but more often it is one of several co-dominants. In the poorer types of forest the dominant or co-dominant eucalypt species include red box (*E. polyanthemos*), brittle gum (*E. mannifera*) and scribbly gum (*E. rossii*). On somewhat better sites there may be narrow-leaved peppermint (*E. radiata*), candlebark (*E. rubida*), silvertop ash (*E. sieberi*) and mountain gum (*E. dalrympleana*). There may be several stringybarks, including red stringybark (*E. macrorhyncha*), and rough-barked apple (*Angophora floribunda*).

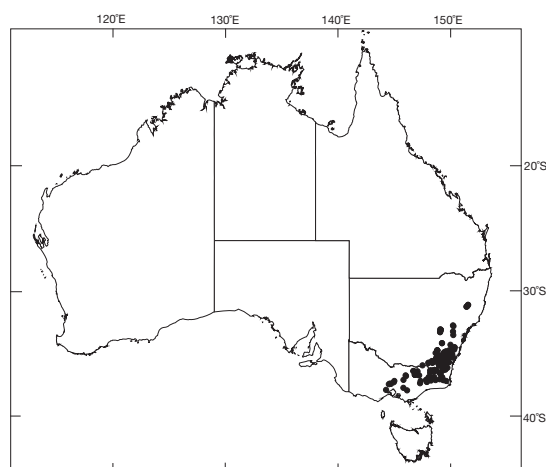
Related species: The peppermints belong in section *Aromatica*, named because of their strongly scented leaf oils (Brooker 2000). Broad-leaved peppermint is distinctive in the field with its broad, opposite, ovate, sessile, pruinose or grey-green juvenile leaves. It also tends to grow on drier, poorer sites than the other peppermints. Gippsland peppermint (*E. croajingolensis*) has broad leaves and is closely related. Its leaves differ in being thinner, dull and bluish rather than green and usually glossy as seen in *E. dives*; its sapling leaves are also borne on pendulous branchlets.

Publication: In *Walpers Repert. Bot. Syst.* 2, 926 (1843). Type: 'Forestland north of Bathurst', New South Wales, Dec. 1822, A. Cunningham 181.

Names: Botanical—Latin *dives* (rich, plentiful), allusion obscure but possibly refers to the flowering habit or to the abundance of essential oil in the leaves. Common—refers to the broad leaves (particularly juvenile) and to the peppermint group of eucalypts.

Bark: Rough and persistent on the trunk and large branches, peppermint-type, subfibrous, with interlaced strands, dark grey or brown; smaller branches smooth, greyish.

Leaves: Seedling—opposite, sessile, amplexicaul, sometimes connate, ovate, 5–8 × 3–5 cm, dull greyish blue to pale green, slightly discoloured; stems sometimes slightly pruinose.



Juvenile—opposite, sessile (becoming shortly petiolate at transition to intermediate stage), amplexicaul, sometimes connate, ovate, 8–15 × 3–7 cm, bluish green to greyish blue or pale green, becoming concolorous. Adult—alternate, petiolate, broad-lanceolate, tapering to a fine point, 7–15 × 1.6–3.3 cm, green, usually glossy, concolorous.

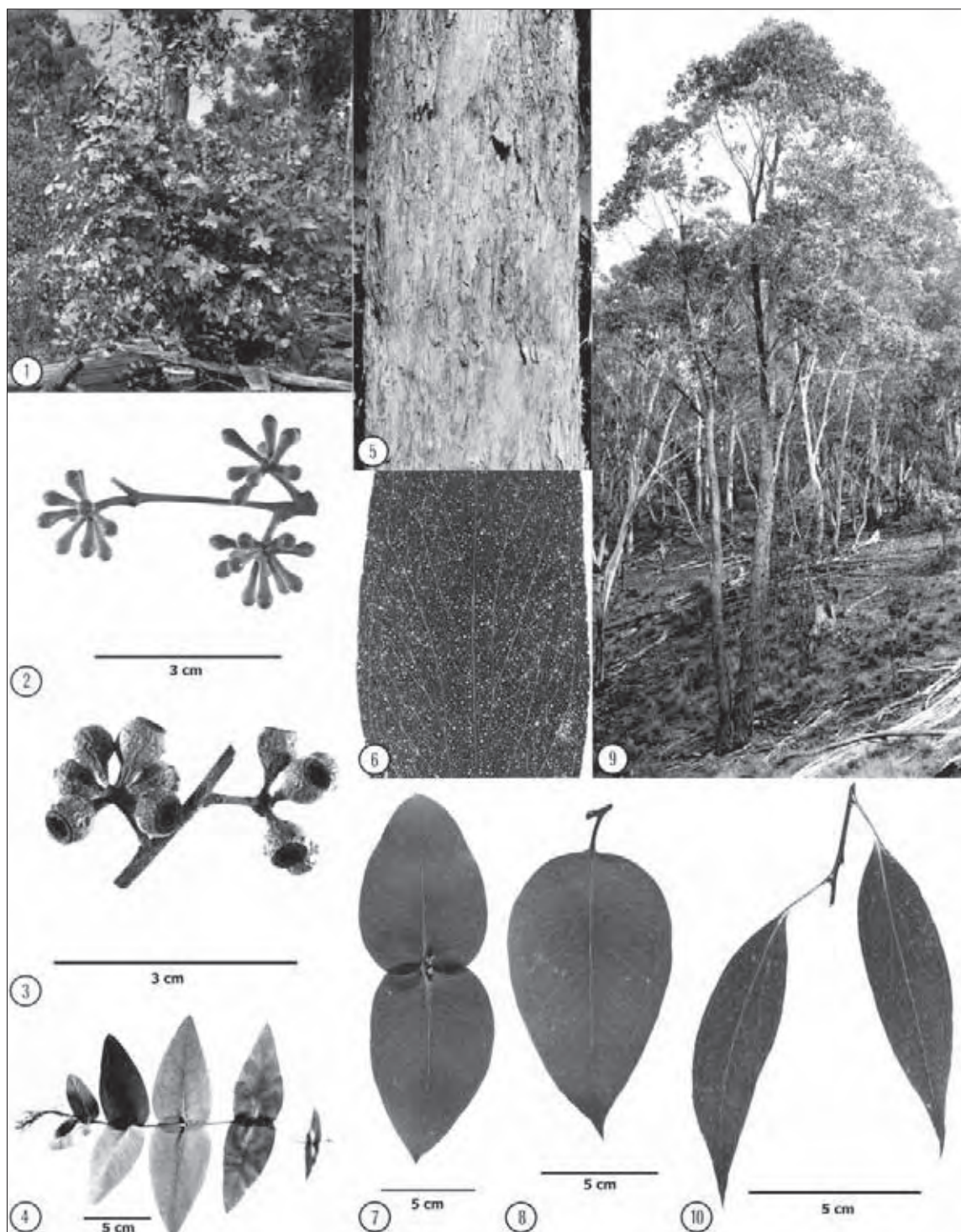
Inflorescences: Simple, axillary, 11–15 or more flowered; peduncles terete to angular, 0.5–1.3 cm long; pedicels 0.2–0.5 cm long; buds clavate, 0.5–0.6 × 0.3–0.4 cm; opercula hemispherical, often apiculate. Flowers Sept.–Oct.

Fruits: Shortly pedicellate, ovoid, obconical, or hemispherical, 0.5–0.7 × 0.4–0.7 cm; disc relatively broad, more or less level to slightly ascending, usually convex; valves 3 or 4, about rim level. Seeds pyramidal or obliquely pyramidal, brown or red-brown, hilum terminal.

Wood: Heartwood light brown, fairly hard and tough, moderately strong, grain usually straight, kino (gum) veins are common and shrinkage and checking high, fissile, easy to work but not durable and of less value than the other peppermints; density 640–855 kg m⁻³; used for local construction purposes.

Climate: Altitudinal range: 150–1400 m; Hottest/coldest months: 22–33°C/–4–4°C; Frost incidence: moderate to high (up to 50–80 each year and snow at high elevations); Rainfall: 600–1100 mm per year, winter max. to uniform.

Distinctive features: Small to medium-sized tree with typical peppermint-type bark on trunk and larger branches but shed from the smaller branches; juvenile leaves opposite, sessile, ovate, thick, usually pruinose; adult leaves broad-lanceolate, green, glossy, with numerous oil glands. In some areas the leaves are still harvested for distillation of oils, mainly cineole and piperitone.



Eucalyptus dives 1. Coppice growth of juvenile leaves 2. Buds 3. Fruits 4. Seedling 5. Bark 6. Adult leaf venation 7. Juvenile leaves 8. Intermediate leaf 9. Tree, near Jerangle, N.S.W. 10. Adult leaves

Brush Box Pink Box, Queensland Box

Lophostemon confertus (R. Br.) Peter G. Wilson & J.T. Waterh.

Brush box is commonly a tall tree, usually 35–40 m in height and 1–2 m in diameter. The largest specimen in New South Wales is 54 m tall and 3.17 m in diameter. The trunk is usually straight and of good form. The rough basal bark and the pink gum bark of the upper trunk make this a very distinctive species in the forests of the east coast of Australia. The crown is rather dense and consists of tiered clumps of glossy green foliage.

Brush box is mainly distributed from near Newcastle, New South Wales, to Fraser Island, Queensland. The species extends farther north as isolated stands to the Windsor Tableland, near Mossman.

This species prefers valleys and slopes in locations varying from coastal lowlands to mountains and the coastal escarpment of tablelands. It can also occur on ridges and other exposed situations. In the Coffs Harbour area of New South Wales it occurs as a stunted form on exposed coastal headlands. Best development is on rather heavy, fertile soils, especially alluvials, but will grow on a wide range of soils including sandy loams derived from sandstone.

Brush box is most common in tall open forests forming a transition between rainforest and eucalypt forest, associated with flooded gum (*Eucalyptus grandis*), tall-wood (*E. microcorys*) and turpentine (*Syncarpia glomulifera*) and various rainforest species. On occasions it occurs in rainforests.

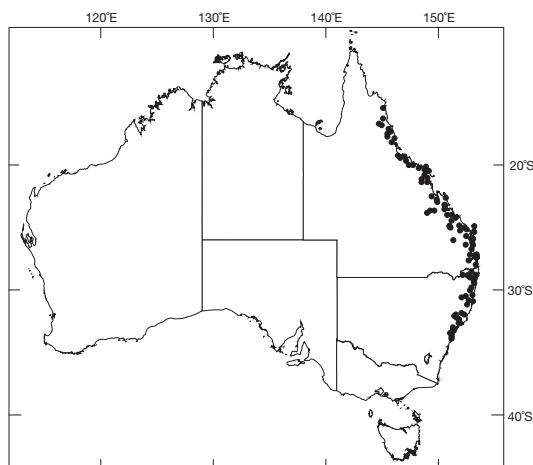
Related species: Brush box was placed in the genus *Tristania* prior to a revision by Wilson and Waterhouse (1982). There are three other *Lophostemon* species (*L. suaveolens*, *L. grandiflorus*, *L. lactifluus*), although none of these are as important economically as brush box. It is somewhat isolated in the genus due to its mainly smooth bark, its caducous, subulate sepals and its long, narrow, staminal fascicles.

Publication: *Aust. J. Bot.*, 30, 424 (1982). Type: Hunter River, R. Brown (Bennett sheet No. 4816); upper specimen on sheet.

Names: Botanical—*Lophostemon* Greek *lopho* (crest, crested), Greek *stemon* (a thread), in reference to the stamens which have gland-tipped dorsifixed anthers; Latin *confertus* (crowded), in reference to the crowding of the leaves near the ends of the branchlets. Common—'brush' because of its usual habitat and 'box' probably because its lower bark is similar to the bark of the 'box' species of eucalypts, or perhaps because of the character of its timber.

Bark: Usually persistent on the lower part of the trunk, light grey or brown, shortly fibrous and tending to be scaly. Shed from the rest of the trunk and branches, leaving a pinkish-cinnamon to orange-brown or red-brown surface with cream vertical threads.

Leaves: Cotyledons—shortly petiolate, green, broadly rhomboid, 0.2–0.4 × 0.2–0.3 cm. Seedling—opposite; very short petioles to 1.5 cm; elliptical, 1–2.5 × 0.5–1 cm, dark green above and paler beneath; venation reticulate, midrib and secondary veins prominently raised on underside of leaf. Underside of leaves and young stems is covered with fine hairs; white liquid exudes from petiole when cut and seedlings are



lignotuberous. Adult—alternate, grouped in false whorls of 4–5 leaves at the end of each season's growth; petioles 2–2.5 cm long; ovate to elliptical, 10–14 × 4–4.5 cm, glossy dark green above, discolorous; venation moderately conspicuous, widely spaced, at 60–80° to the midrib. Young shoots hairy, young buds protected by overlapping widely based scales during winter in a resting bud.

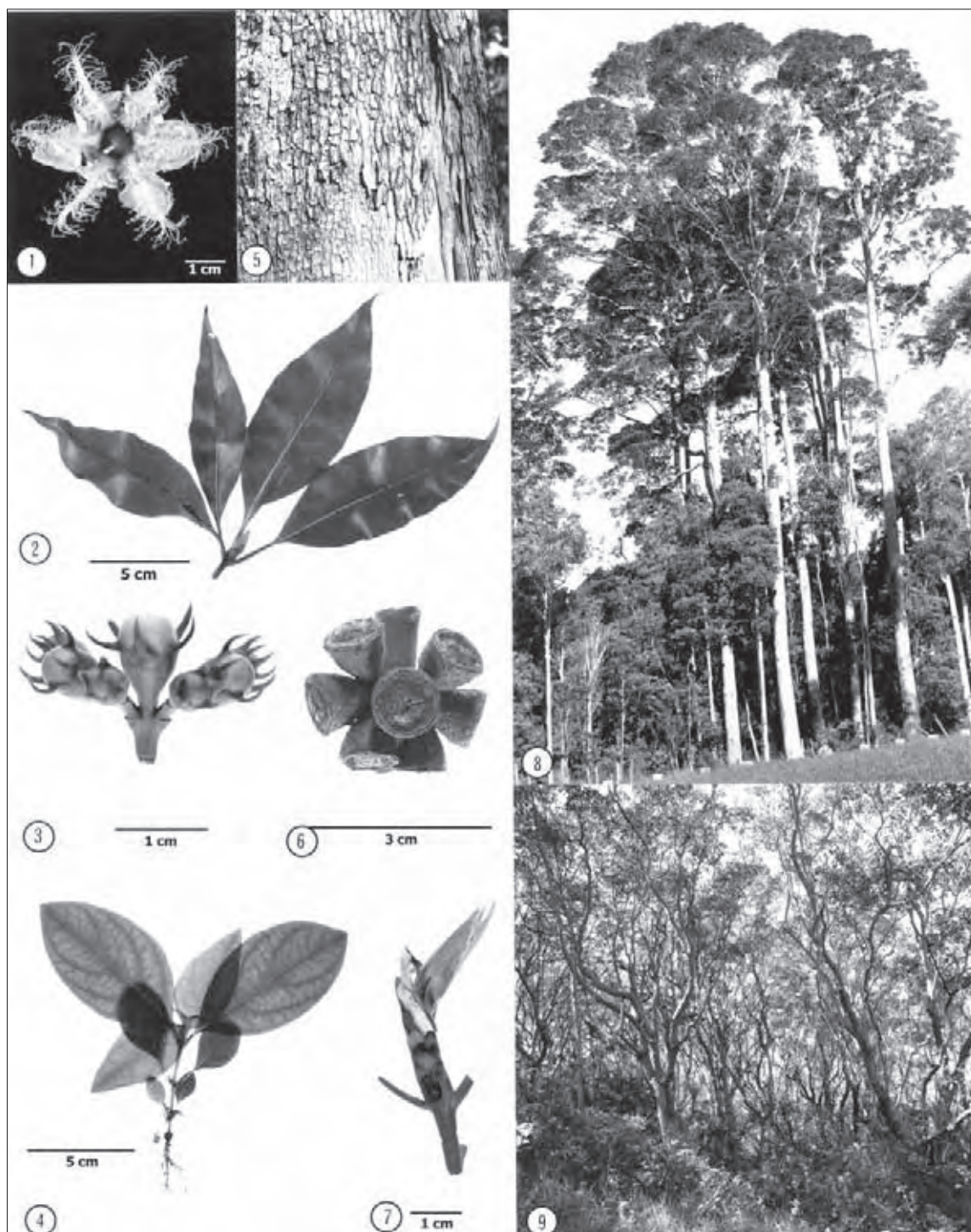
Inflorescences: Axillary cymes of 7 flowers. Calyx tube ovoidconic, 0.5–1 cm long, covered by short fine hairs; 5 calyx lobes short, obtuse, 0.2–0.25 cm long. Petals 5, white, broad with a wavy margin, 1–1.5 cm long, overlapping in the bud. Stamens white, numerous, united into 5 feathery bundles 1.5–2 cm long, opposite the petals. Ovary inferior, 3-locular, with several locules per loculus. Style single, straight, slender. Flowers Dec.–Feb.

Fruits: Capsules, shortly pedicellate (0.1–0.2 cm long), hemispherical-campanulate, 0.8–1 × 0.7–1 cm, woody with a smooth surface, valves 3, enclosed more or less at rim level; occasionally having persistent calyx lobes; seeds few in each cell, narrowly wedge-shaped; the placental column deciduous.

Wood: Sapwood pale and seldom attacked by *Lyctus* borers; heartwood light to medium pinkish brown, texture fine, grain often curly and interlocked, strong, very tough and hard, density 745–965 kg m⁻³. It is fairly resistant to termite and marine borer attack but is only of moderate durability against decay. The timber works well, finishes smoothly but dulls tools due to the high silica content. It is used for bridge and wharf decking, flooring, makes excellent parquetry and is also useful for general construction while special uses include mallets, woodworking planes and pulley blocks. The wood has exceptionally good wearing properties. The wood is superficially similar to myrtle beech (*Nothofagus cunninghamii*).

Climate: Altitudinal range: near sea level to less than 800 m; hottest/coldest month: 25–30°C/2–10°C; Frost incidence: low to moderate (with 10–25 each year at higher altitudes); Rainfall: 900–1700 mm per year, summer max.

Distinctive features: The bark and fruits resemble those of a eucalypt but the glossy, ovate adult leaves grouped in false whorls, the bases of the stamens united into 5 bundles and the deciduous placental column of the fruit are distinctive.



Lophostemon confertus 1. Flower illustrating the filaments in bundles 2. Adult leaves with resting bud 3. Floral buds 4. Seedling 5. Bark 6. Fruits before dehiscence 7. New leaf emerging from the resting bud 8. Stand, forest form, Dome Mtn near Dorrig, N.S.W. 9. Stand, coastal headland form, Charlesworth Bay, near Coffs Harbour, N.S.W.

Swamp Box Apple, Swamp Mahogany, Swamp Turpentine

Lophostemon suaveolens (Sol. ex Gaertn.) Peter G. Wilson & J.T. Waterh.

Swamp box is a small to medium-sized tree up to 15 m tall and with diameters of 0.5–1 m. Individual trees usually have twisted, distorted branches. The foliage is typically light green in colour and is clumped at the ends of the branches, giving the crown a very open appearance.

This species typically occurs along the east coast of Australia from near Scotts Head, New South Wales, in the south to the tip of Cape York in the north. The species extends inland from the coast near Grafton and Kyogle, New South Wales, and inland near Toowoomba, Dalby and Rockhampton (Blackdown Tableland) in central coastal Queensland. There is a gap in the distribution between Mackay and Rockhampton but the species is common in the Tully, Cairns, Cooktown and Mareeba areas. Farther north the species occurs on the Windsor Tableland and the Iron and McIlraith Ranges and insular occurrences include Fraser, Stradbroke and Lindeman Islands.

The species typically favours swampy alluvial ground near the coast but can form quite big trees on drier hill-sides. In its inland occurrences it usually occurs in depressions or along the sides of small streams.

Swamp box occurs commonly in tall open forests but extends to woodland sites and also to the fringes of closed rainforests. It is common as scattered individual trees beneath eucalypt species such as swamp mahogany (*E. robusta*) and forest red gum (*E. tereticornis*) and often occurs with swamp oak (*Casuarina glauca*), five-veined paperbark (*Melaleuca quinquenervia*) and long-leaved paperbark (*M. leucadendra*) near the coast.

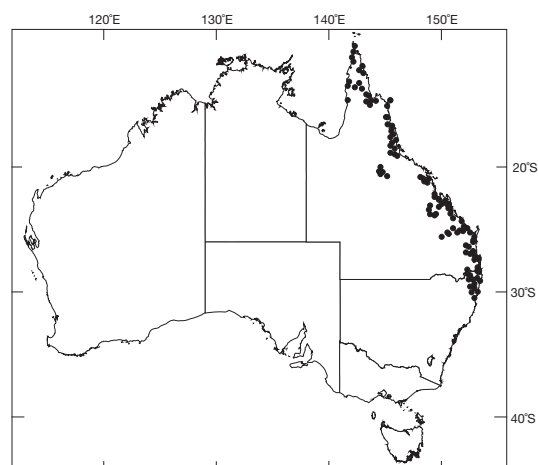
Related species: Swamp box was placed in the genus *Tristania* prior to a revision by Wilson and Waterhouse (1982). There are three other *Lophostemon* species and of these swamp box is most closely related to northern swamp box (*L. grandiflorus*), which occurs across northern Australia from the Kimberley region in Western Australia and Northern Territory to Queensland, extending as far south as the Blackdown Tableland. It differs in its distinctive hard, persistent bark and its 18–33 stamens per bundle.

Publication: *Aust. J. Bot.*, 30, 425 (1982). Type: The holotype of *Melaleuca suaveolens* Sol. ex Gaertn. is the basionym for *L. suaveolens* but could not be located by P.G. Wilson and J.T. Waterhouse. They cite illustrations in Gaertner, J. (1788), *De Fructibus et Seminibus Plantarum* 1, 173, t. 35, fig. 1, that typify *L. suaveolens*.

Names: Botanical—*Lophostemon* Greek *lopho* (crest, crested), Greek *stemon* (a thread), in reference to the stamens, which have gland-tipped dorsifixed anthers; *suaveolens*, from the Latin *suaveolens* (fragrant), in allusion to the sweet smell of the flowers. Common—alludes to its preferred habitat and the character of either its bark or wood (see also *L. confertus*).

Bark: Brown to grey, soft, flaky and somewhat fibrous, extending to the ends of smaller branches.

Leaves: Seedling—opposite; petioles to 0.8–1 cm long and reddish; broad lanceolate, 10–15 × 3–5 cm, shiny dark-green above and paler beneath, almost glabrous above and densely



hairy beneath; venation reticulate, raised and prominent beneath. Stems hairy. Adult—alternate, grouped in false whorls of 3–4 leaves; petioles to 1–2 cm long and hairy; ovate to elliptical, 8–13 × 4–5 cm, tapered at both ends, light green above and paler beneath; about 9–10 pairs of lateral veins at about 45° to the midrib, midrib raised beneath and somewhat sunken above. Resting buds conspicuous during winter and with glabrous overlapping scales, new growth densely hairy. Petioles exude a milky liquid when cut.

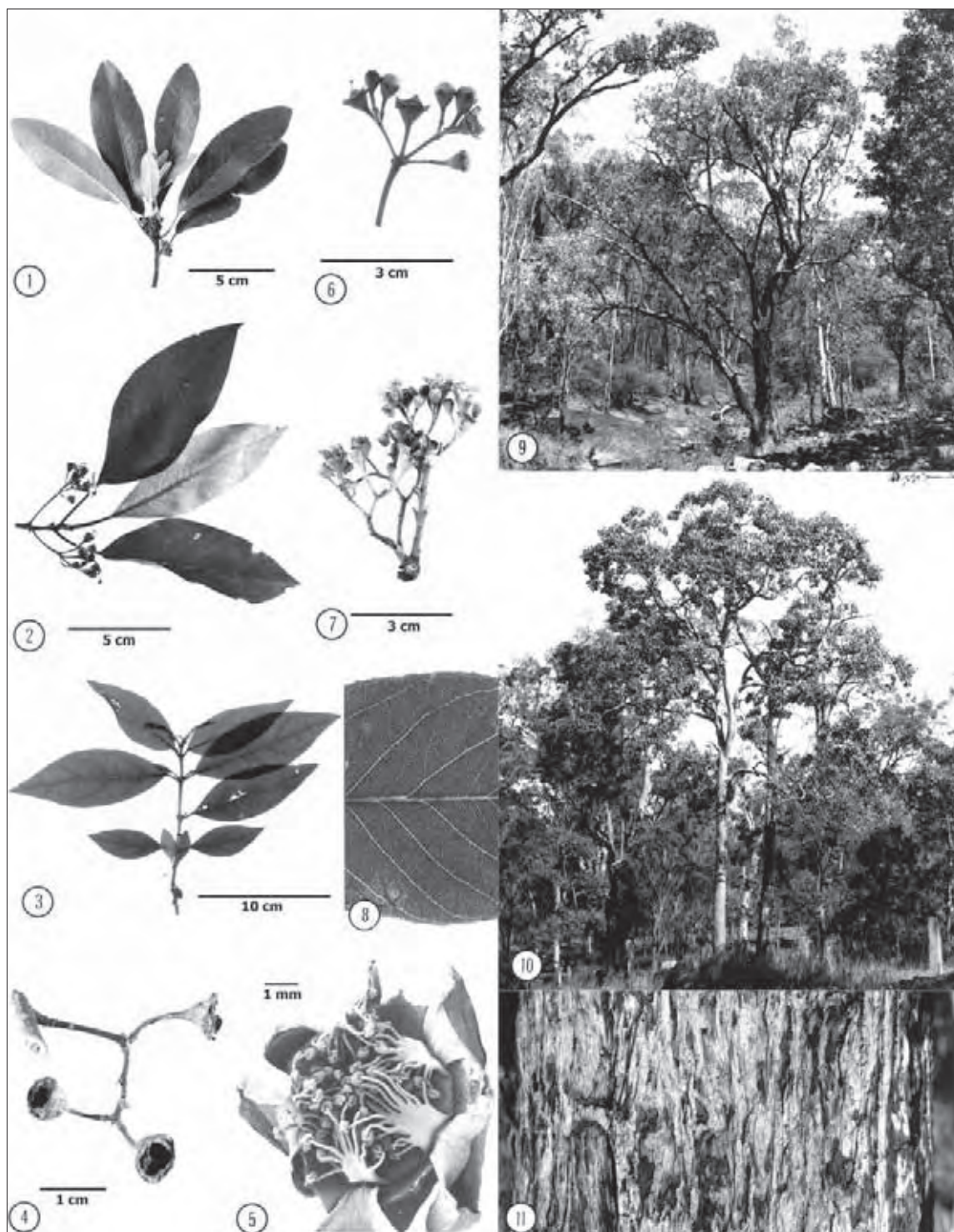
Inflorescences: Dichotomous cymes, 7(3)-flowered, about 6 cm long and often hairy; buds clavate, about 0.4–0.5 × 0.3–0.4 cm, filaments inflexed, with free sepals and imbricate petals. Each flower has 5 subulate sepals about 0.2–0.45 × 0.2–0.45 cm, 5 bundles of 30–40 stamens fused at their bases and free above, about 0.3 cm long and half as long as the petals. Petals white, with narrow bases and orbicular above, about 0.3–0.5 × 0.3–0.4 cm. Ovary inferior, 3-locular, with several ovules per loculus. Style columnar with flattish stigma. Flowers Nov.–Jan. and produces nectar of good quality for honey production.

Fruits: Capsules, pedicellate (0.4–0.5 cm long), hemispherical, about 0.4–0.5 × 0.4–0.7 cm, thin walled, 5 broad-based persistent sepals, 3 deltoid valves barely emergent above the fruit rim, seeds linear-cuneate. Placental column deciduous.

Wood: Sapwood thin and pale and not susceptible to *Lyctus* attack; heartwood pinkish, deepening in colour on exposure and dark red-brown towards the pith, fine and even texture somewhat interwoven, short and brittle grain, reputedly not termite resistant but marine-borer resistant, very durable, density 655–993 kg m⁻³. The wood is reputedly good for piles and underground work. It burns to a soft floury ash of the type favoured by bushmen for making dampers. Wood is similar to brush box (*Lophostemon confertus*).

Climate: Altitudinal range: near sea level to less than 800 m; hottest/coldest month: 27–33°C/10–17°C; Frost incidence: low (but up to 10 each year may occur); Rainfall: 1000–1600 mm per year, summer max.

Distinctive features: A flaky fibrous rough-barked tree with twisted, distorted limbs; thin-walled capsules and dehiscant placental columns.



Lophostemon suaveolens 1. Adult leaves with new leaves emerging from the resting bud 2. Branch with inflorescences 3. Seedling 4. Fruits 5. Flower (S.E.M.) 6. Floral buds 7. Inflorescences 8. Adult leaf venation 9. Stand, near Blackdown Tablelands, Qld 10. Tree, at Moonee, north of Coffs Harbour, N.S.W. 11. Bark

Melaleucas

Melaleuca L. is predominantly an Australian genus, although cajuput (*M. cajuputi*) and some of its closely allied species in '*M. leucadendra* group', have a wider distribution, occurring in India, Malaysia, Indonesia and New Guinea. There are about 250 species of melaleucas represented in all States. The generic name is derived from the Greek *melas* (black, dark), plus *leucon* (white). Trees of the first species described (*M. leucadendra*) had white, paper-like bark with a stocking of black bark, probably due to the effects of fire. A common name in use for species with white papery bark is 'paperbark', with some qualifying adjective. Unfortunately the common name 'tea tree' is also used for both this genus and for *Leptospermum*. In southern Australia the common name 'honey-myrtle' is also well established for many shrub-sized species. A few have distinctive Aboriginal or locality names.

Melaleucas occur in a range of habitats. Some of the better-known species, viz. the tropical '*M. leucadendra* group', have a marked preference for damp or wet sites, which dry out seasonally, particularly on or near the coast and including brackish and saline areas. There are a few, perhaps lesser-known species, which extend from coastal areas to the arid centre of the continent, e.g. *M. bracteata*. Species that grow in seasonally flooded sites develop adventitious roots, which arise at various heights on the stems and attain diameters of 1–2 cm.

Most species of the larger paperbark group often grow in forest, sometimes only a few trees wide, fringing the edges of streams or wet swamps. Where the swamps are seasonal the species may form almost pure stands and on flat land with good sub-soil moisture adjacent to streams they occur with eucalypts in mixed tall open forests. Rarely, species such as *M. leucadendra* may occur in closed rainforest.

Some of the large shrub/small trees of southern Australia, well exemplified by *M. lanceolata*, occur in low woodlands or tall shrublands, while the many smaller species (typically most Western Australian members of the genus) are less distinctive in their habits and often occur as scattered shrubs in heaths or low shrublands or as a component of the shrub layer in open forests. Cajuput has been recorded with heights up to 46 m in the Northern Territory and is the tallest tree in the region; similarly *M. leucadendra* has been measured to 43 m in Cape York Peninsula, Queensland. Western Australia has the most species, over 100, mostly endemic and in the height range of 1–4 m; only four are classified as trees in the south-west of the State.

There is a great range of soil types on which the various species grow, from the predominantly silty to loamy clays along the edges of swamps and river banks preferred by species such as *M. leucadendra* and *M. quinquenervia*, to the shallow terra rossa soils over limestone, as well as skeletal types, on which *M. lanceolata* may be the only shrub. Other soils include siliceous sands, often over clay at depth, saline and sodic types, clay pans and, for at least one species, the black soil plains of south-eastern Queensland. For many species high watertables are critical.

Melaleuca bark, leaves, flowers and fruits are often distinctive. The leaves are mainly alternate (in a few species opposite or occasionally ternate), entire, usually coriaceous, flat, concave or semiterete, sessile or very shortly petiolate. They vary in size from small, often ericoid, less than 1 × 0.2 cm, to moderate size, broadly lanceolate and up to about 20 × 6 cm. The larger leaves often have 3–7 fairly prominent longitudinal veins; other venation is frequently obscure. The flowers are sessile, often in open or condensed spikes, the axes of which continue vegetative growth or resume such growth after flowering and fruiting; they may also occur in

heads, or solitary, or in threes scattered along the twigs. The filaments of the stamens are most frequently whitish or creamy, but light green, yellow, pink, mauve or a colour between crimson and purple may occur. The ovary is a wholly or partly enclosed in the hypanthium, i.e. inferior or semi-inferior. The fruit is a woody capsule, often globular or ovoid and usually not greater than about 0.5 × 0.5 cm. In southern Australia the fruits are typically persistent and, in a few cases, the wood of the twigs may grow around the bases of the capsules. In the tropics the main flowering usually associated with the end of the wet season and capsules shed soon after ripening.

The bark of most of the medium size and larger tree species is very distinctive. It consists of thin, whitish to light brownish, paper-like layers of cork, separated by thin fibrous layers. It may build up to 5 cm or more in thickness before it finally peels off. On the lower parts of the trunks the outer layers are looser and usually become torn, ragged and partly unrolled. By contrast, in a number of other melaleucas, e.g. *M. lanceolata*, the bark is dark grey to almost black, subcompact to compact and hard, and deeply corrugated more or less longitudinally.

The leaves and twigs of several species of melaleucas contain valuable essential oils which can be extracted by steam distillation. The first oil to attain medical and pharmacological recognition was cajeput or cajuput, a general name applied to broad-leaved paperbarks (*M. cajuputi* and *M. leucadendra*), which extend from India and South-East Asia to northern Australia. Cajeput oil has long been used for its germicidal properties and as a powerful anti-spasmodic diffusible stimulant and as a sudorific, while in India it has been used as an external application for rheumatism.

Several of the Australian species produce useful oils. The most important is *M. alternifolia*. This oil is non-toxic and non-irritant and has the unique power to penetrate wounds and slough off pus, leaving a healthy surface. It has been used for throat and mouth conditions, including catarrh, thrush, tonsillitis, ulcers, pyorrhoea and gingivitis, as well as such other infections as tinea.

The timber of most of the larger melaleuca species is moderately dense (700–850 kg m⁻³), hard, and often cross-grained, while sawn material does not season readily. Some species contain 0.5 per cent or more of silica, thus quickly blunting saws and planing knives. Formerly the wood was used for a wide range of purposes including marine piling (with the bark left on), knees in boats, rough framing and flooring. Not only is the wood durable in water and in the ground, the wood of most species is highly resistant to termites.

Melaleucas are used in amenity planting in Australia under conditions which vary from a 1200 mm monsoonal rainfall, as at Darwin, Northern Territory, to semi-arid conditions with a variable rainfall averaging less than 250 mm, as at Broken Hill, New South Wales. Some of the larger species, such as *M. dealbata* and *M. leucadendra* have a use in public parks and esplanades subject to sea spray and where soil drainage may be poor. Several of the southern shrubs of 3–5 m height, have a dense branching habit from ground level and provide effective low windbreaks for homes and shelter for stock, especially sheep, in the dry country. These species include bracelet honey myrtle (*M. armillaris*), South Australian swamp paperbark (*M. halimifolium*), moonah (*M. lanceolata*) and *M. pauperiflora*. Moonah will also tolerate shallow soils and sea spray.

Tea Tree *Narrow-leaved Paperbark*

Melaleuca alternifolia Maiden & E. Betcher ex Cheele

Tea tree may either be a shrub 2–3 m tall or a small tree up to 14 m tall. The bole may be up to one quarter the tree height and rarely greater than 30 cm dbh. Branching tends to be ascending but on older specimens the fine branches become contorted. The crown, which can be nearly as wide as the tree is high, has dense soft foliage and is comprised of innumerable fine leaves. The characteristic papery white bark extends to the finest branches.

Tea tree is most common in the Grafton-Lismore-Casino region on the north coast of New South Wales. It extends inland to around Tabulam near the Richmond Range. Outliers occur to the north-west in the Stanthorpe-Ballandean area in Queensland. These populations have a shrubby habit. There is a highly disjunct occurrence nearly 200 km to the south of its main distribution near Port Macquarie, New South Wales.

This species occurs on coastal plains and adjacent ranges where it grows on seasonally inundated swamps or along watercourses. In the main part of its range soils are mainly alluvial silty loams, while in the Stanthorpe-Ballandean area they are sandy loams derived from granite.

Tea tree usually occurs in pure stands or sometimes in proximity to open forests and woodlands dominated by eucalypts. Across its range it occurs with numerous other species including shrubs from the genera *Acacia*, *Melaleuca*, *Leptospermum* and tree species such as *Eucalyptus pilularis*, *Angophora subvelutina* and *A. robur*.

Natural stands of this species have been harvested for the production tea tree oil since the 1930s.

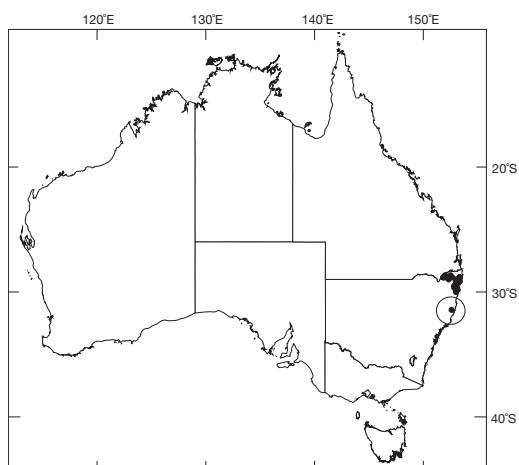
Related species: Tea tree belongs to a group of closely related species that includes *M. linariifolia*, *M. trichostachya*, *M. dissitiflora* and *M. linophylla*. Its closest relative is the partially sympatric *M. linariifolia*. Hybrids between the two have been confirmed based on DNA evidence in the highly disjunct Port Macquarie population (Butcher *et al.* 1995). The more or less opposite leaves, which are longer, wider (2–4.5 × 0.2–0.4 cm), readily distinguishes *M. linariifolia* from *M. alternifolia*.

Publication: *J. Proceed. Roy. Soc. N. S. W.* 58, 195 (1924). Type: Coff's Harbour to Grafton, J.H. Maiden and J.L. Boorman, Nov. 1903.

Names: Botanical—Latin *alterni* (alternate), *folia* (foliage), apparently refers to its leaves despite being arranged irregularly. Common—a number of species of *Melaleuca* and *Leptospermum* share this common name, which is attributed to early pioneers who made an infusion or tea from their leaves.

Bark: Layers of papery, white sheets, shedding in thin layers, extending to the finest branches.

Leaves: Seedling—arranged irregularly, shortly petiolate, linear, about 0.5–2 × 0.5–0.7 cm, thin, glabrous. Adult—arranged in irregular spirals, scattered to whorled, petiole ca 1 mm long, linear, 1–3.5 × 0.1–0.2 cm, thin, glabrous, reticulation not prominent, apex acute but soft; oil glands numerous. Leaves contain terpinen-4-ol, which has medicinal (antibacterial) properties.



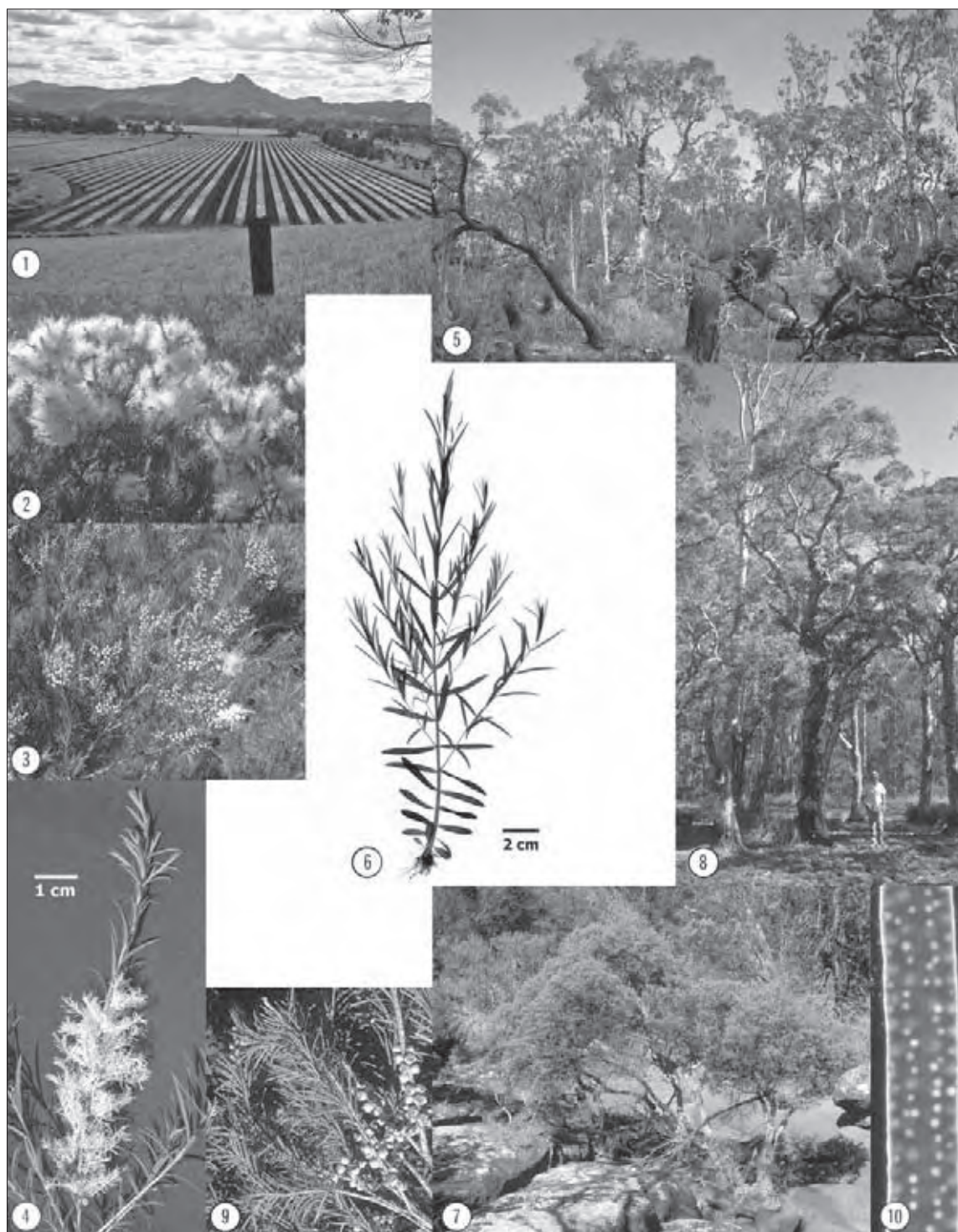
Inflorescences: Spikes, terminal or in terminal axils, 3–5 cm long, up to 30 flowers per spike, rachis shortly pubescent; flowers white, one per bract, petals 2–3 mm long, 30–60 stamens per bundle, style 3–4 mm long. Flowers Aug.–Oct.

Fruits: Capsules, cupular, sessile, 0.2–0.3 × 0.2–0.3 cm; valves sunken; from anthesis capsules take 18 months to mature.

Wood: Limited details available; density is likely to be similar to the closely related *M. linariifolia*, which has a basic density of around 590 kg m⁻³; used in oyster beds.

Climate: Alt. range: near sea level to 950 m; Hottest/coldest months: 25–30°C/1–9°C; Frost incidence: low to moderate (up to 50 at high elevation sites); Rainfall: 750–1600 mm per year, summer max.

Distinctive features: Papery, white bark and a crown that has innumerable, fine narrow leaves, which are only c. 1 mm wide, that are arranged in irregular spirals along the stems. The leaves contain terpinen-4-ol, which has medicinal (antibacterial) properties and is marketed as Tea Tree Oil. This oil has been produced in large-scale plantations over the past 20 years.



Melaleuca alternifolia 1. Plantation near Mullumbimby, N.S.W. 2, 3. Profuse production of flowers and buds 4. Inflorescences and adult foliage 5, 8. Stand and tree, near Lismore, N.S.W. 6. Seedling 7. Shrub, near Stanthorpe, Qld 9. Fruits with adult foliage 10. Leaf oil glands.

Blue-leaved Paperbark Blue Paperbark, Soapy Teatree, Cloudy Teatree

Melaleuca dealbata S.T. Blake

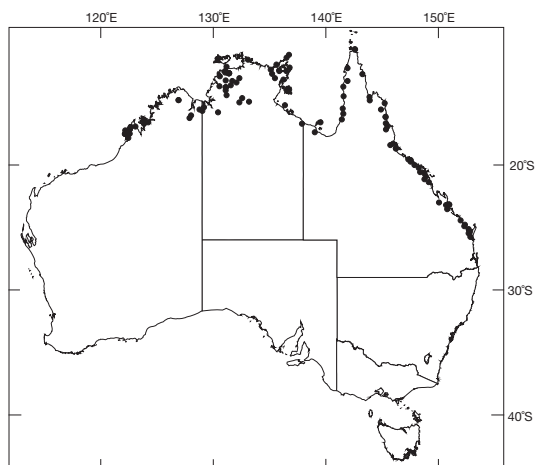
Blue-leaved paperbark is usually a medium-sized tree often 15–20 m tall and 0.5–1 m in diameter, with a moderately straight trunk for half or more of tree height. Under favourable conditions the tree attains 25–28 m and diameters of 1–1.5 m; under very unfavourable conditions the species may be reduced to a poorly shaped shrub of 6–8 m. Its small branchlets and twigs are pendulous.

This species occurs in the north and north-east of Australia. It is fairly common in coastal Queensland north of Maryborough and is scattered across the northern part of the Northern Territory to the Dampier Peninsula in Western Australia. While the species grows typically within 20–40 km of the sea it may extend further inland along the swamps of major rivers, such as the Adelaide River of the Northern Territory, and there is an occurrence along waterways near Katherine, some 300 km inland; it also occurs in the southern lowlands of New Guinea.

This species occurs on flats and old dune areas immediately behind the foreshore, along estuaries and swamps of major rivers and the banks of streams and waterholes. The water may be fresh or brackish and water levels fluctuate seasonally. The topography is usually level to gentle. The soils often have leached sands in the upper layers but with mottled clays in the lower horizon. Sometimes the A horizon may be up to 0.6 m deep. On drier sites, the soils are often sandy or gritty in the upper layers and may even include shallow soils of volcanic origin.

Blue-leaved paperbark occurs in open forests and woodlands and may be a dominant or co-dominant species on old dune areas or in some swamp forests. In such areas it may be with other melaleucas such as *M. argentea*, long-leaved paperbark (*M. leucadendra*), five-veined paperbark (*M. quinquenervia*) and broad-leaved paperbark (*M. viridiflora*). Less commonly there may be *M. nervosa*. It may also form very narrow belts of forest fringing riverbanks and around waterholes. In the 'beach scrub' formation associated species may include tuckeroo (*Cupaniopsis anacardioides*), grey boxwood (*Drypetes acuminata*), *Ficus* spp. palms (*Livistona* sp.) and eucalypts such as carbeen (*E. tessellaris*).

Related species: This species resembles *M. nervosa* more closely than other species but usually has larger leaves with more persistent indumentum, longer and narrower spikes and shorter and more numerous stamens. The indumentum is much less silky than in *M. argentea*, the leaves are broader, with more prominent reticulations, and the stamens are more numerous and shorter. Sometimes it can be confused with *M. cajuputi*, but can be distinguished by the presence of crisped hairs on young leaves, the absence of a broad thin glabrous margin to the sepals and the usually coarser veins. Where it grows in association with *M. leucadendra* the rougher bark with brown blotches is in strong contrast to the smoother and usually very white bark of that species.



Publication: *Contr. Qld Herb.* 1, 41–3 (1968). Type: 25 km south of Darwin, Northern Territory, S.T. Blake.

Names: Botanical—*dealbata*, from the Latin *dealbatus* (covered with a white powder, whitened), in allusion to the hoary-tomentose young shoots and the young but fully grown leaves. Common—refers to leaf colour, but while the crown is strikingly 'bluish' shortly after the first flush of new leaves, the colour fades as the leaves lose the tomentum.

Bark: A paperbark with brown blotches and with a rough surface.

Leaves: Seedling—alternate, shortly petiolate, oblanceolate, about 5–6 × 1.5–2.5 cm at the 6th node, prominently trinerved, foliage soft and stem and leaves covered with fine, soft, downy hair. Adult—alternate, petioles to 0.6–1 cm long, lanceolate to oblanceolate, oblique, mostly 7–12 × 1.5–2.5 cm, coriaceous, closely and densely tomentose, partly or wholly disappearing with age. Prominently 5–7 nerved, reticulation prominent.

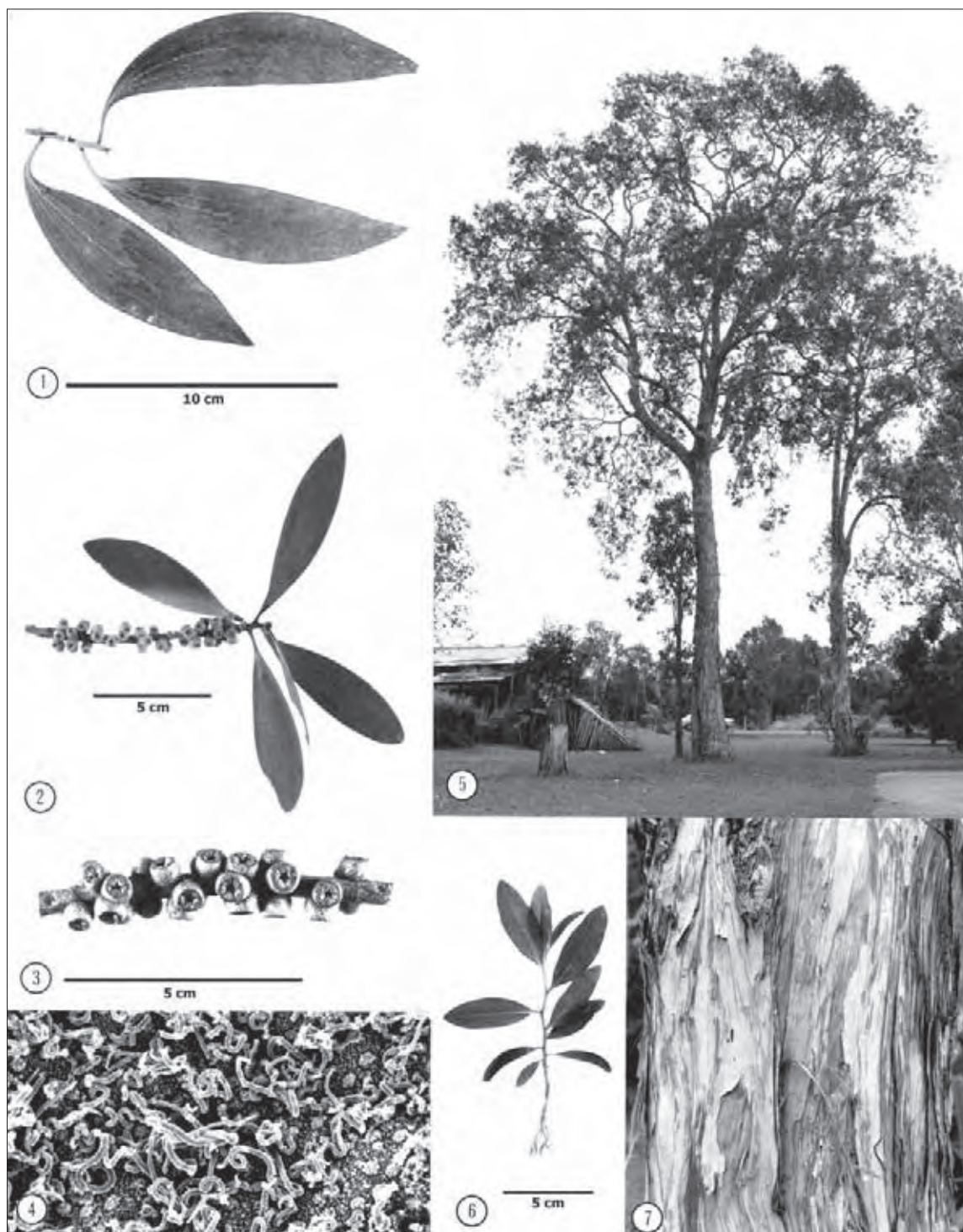
Inflorescences: Spikes, either terminal and 1–4 together or axillary, sometimes several on leafless twigs, loose-flowered, usually 7–12 × 2 cm but some spikes may be up to double the length of the leaves. Flowers creamy-white, sometimes with a sickly honey scent.

Fruits: Capsules, sub-cylindrical, often widest at the sessile base, 0.3–0.4 × 0.3–0.5 cm; wide opening and valves sunken. Fruits less persistent than in southern species and may fall early in the first season (particularly in the far north of its range).

Wood: No details available.

Climate: Altitudinal range: near sea level to 100 m; hottest/coldest months: 31–37°C/8–19°C; Frost incidence: low (occasional in the south or inland); Rainfall: 900–1500 mm per year, summer max.

Distinctive features: Usually a tall tree with brownish paperbark; crown foliage bluish, particularly new growth; mass flowering events produce a strong sweet scent.



Melaleuca dealbata 1. Adult leaves 2. Fruiting branch 3. Fruits 4. Crisped leaf hairs (S.E.M.) 5. Tree, Machans Beach, Cairns, Qld 6. Seedling 7. Bark

Moonah Rottneist Island Teatree

Melaleuca lanceolata Otto

Moonah is often a bushy shrub 2–4 m tall and, in open situations, often much wider than tall, with branches retained to ground level. It also occurs as a small, usually irregularly branched tree 5–10 m in height. The latter may have a trunk 1–2 m long or it may be divided into several stems from below 1 m. The canopy is at least moderately dense and provides good shade and shelter.

Moonah extends for nearly 4000 km west to east in southern Australia, chiefly near the coast but extending to over 500 km inland in places. There are isolated occurrences on Dirk Hartog Island and about 200 km south of Wiluna, Western Australia. The relatively small area on the Darling Downs in Queensland appears to be disjunct.

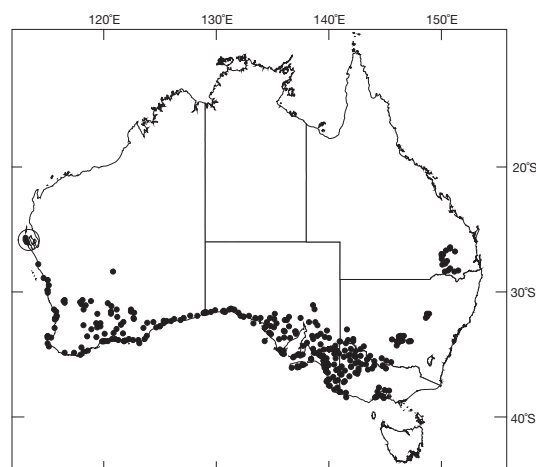
The topography is predominantly level to gently undulating, but colonised sites include narrow belts at the bases of small banks, low coastal plateaux, drainage lines in the drier regions and, somewhat exceptionally, steep rocky slopes, as in the Torrens Gorge near Adelaide. The species tolerates a wide range of parent rock and soil types. It has been recorded on sandstones, limestones, travertines, granites and shales. The soils vary from shallow reddish clays derived from limestone (terra rossas) to deep, light-coloured sandy podosols on sand dunes.

Moonah grows in grassland, heath, open shrubland, open woodland and as a shrub layer in open forests. In coastal areas it may edge mangrove swamps. It is not uncommon in mallee shrublands and may occur in monotypic formations, either as narrow belts or occupying larger areas which other plants find unsuitable. It may grow as a shrub under black box (*Eucalyptus largiflorens*) or with the mallee eucalypts such as *E. rugosa*, *E. leptophylla* and *E. uncinata*.

Related species: Barlow and Cowley (1988) revised the '*M. lanceolata* group' (*M. howeana*, *M. lanceolata*, *M. preissiana*, *M. strobophylla*, *M. xerophila*), and recognised four subspecies of *M. lanceolata*: the typical subspecies which extends from the eastern edge of the Nullabor Plain in South Australia to inland southern Queensland, subsp. *planifolia* occur along the coast of southern Western Australia from the Nullabor Plain west to the Albany region, subsp. *occidentalis* occur in coastal sites along the west coast of Western Australia from Cape Leeuwin north to Dirk Hartog Island, and subsp. *thaeroides* occurs east from the Wongan Hills in Western Australia to the eastern edge of the Nullabor Plain in South Australia. *Melaleuca howeana* and *M. xerophila* differ from moonah in having inflorescences in which the flowers are in monads or not grouped with other flowers (flowers are in groups of 2s and 3s in *M. lanceolata*) and fruit capsules that are not narrow at the aperture (narrowed in *M. lanceolata*). The other two species in the group, *M. preissiana* and *M. strobophylla*, are readily distinguished by their white, papery bark (hard and finely longitudinally furrowed in *M. lanceolata*).

Publication: *Horae Phys. Berol.* 36 (1820). Type: From a cultivated plant in the Berlin Botanic Gardens.

Names: Botanical—*lanceolata*, Latin *lanceolatus* (meaning adult leaves being broadest at the middle and tapering to each



end). Common—the preferred name is Aboriginal, while the alternative name refers to a habitat in Western Australia.

Bark: Dark grey to almost black, sub-compact to hard, strongly corrugated longitudinally in an open spiral. Bark on old trees is 2–3 cm thick.

Leaves: Cotyledons—shortly petiolate, deltoid, about 0.4 × 0.3 cm, green. Seedling—densely arranged on stem, sessile to shortly petiolate, about 0.1 cm long, lanceolate, small, about 1.4–1.6 × 0.2–0.4 cm, dark green and soft, with both leaves and stem covered in fine white hairs up to 0.1 cm long. Adult—alternate or mainly so, somewhat crowded along the shoots, spreading, linear to linear-lanceolate, acute, often curved, 0.5–1.5 × 0.1–0.25 cm. Obscurely 3-nerved, barely discoloured, not oil dotted.

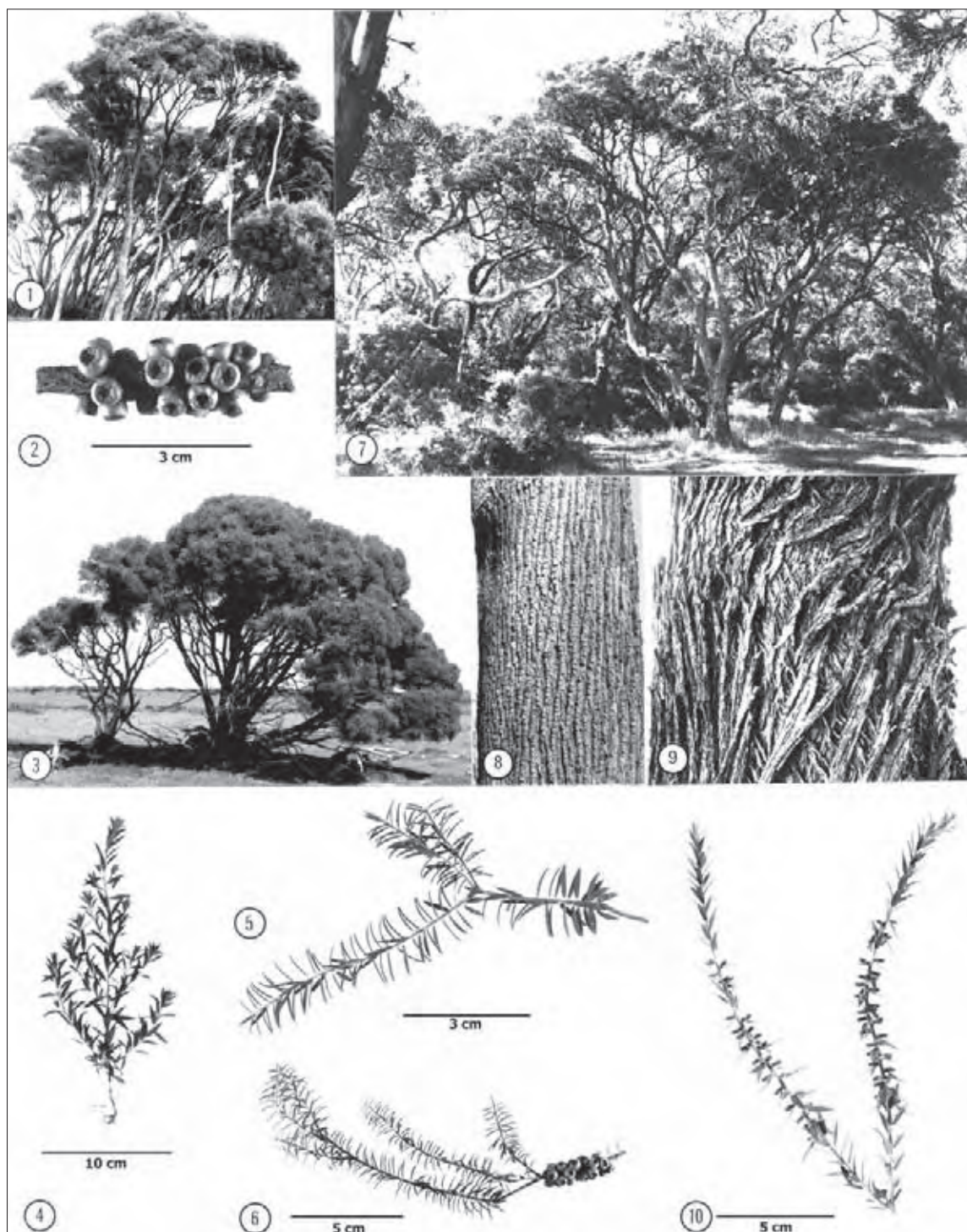
Inflorescences: Mostly ternate in interrupted leafy spikes, flowers in 6–20 triads (in groups of 3), 1–5 × 1.7–2 cm, flowers cream to white, appearing Dec.–Feb.

Fruits: Ovoid to subglobose woody capsules, 0.3–0.45 × 0.2–0.45 cm, opening 1/4–3/4 diameter of fruit. Valves usually deeply enclosed but may be near rim level. Sepals persistent for some time or finally deciduous; fruits usually remain on stems for at least 2 years. Seed very small, elongated, about 0.1 × 0.025 cm, more or less round in cross-section; blackish. There is usually a very large quantity of rod-like brownish-pink chaff slightly larger and lighter in colour than the seed.

Wood: Sapwood narrow, light in colour; heartwood pinkish-brown to brown, tough, hard, density 560 kg m⁻³. The wood is durable in the ground and is a good fuel. Its use is mainly restricted to round fencing material because of the poor form of the stem.

Climate: Altitudinal range: near sea level to 300 (500) m; hottest/coldest months: 24–37°C/3–8°C; Frost incidence: low to moderate (a mean of 1–5 heavy frosts per year in some areas but frost free on coastal sites); Rainfall: mainly 350–650 mm per year, mostly winter max. (except Qld).

Distinctive features: Among the small-medium sized melaleucas this species has hard, corrugated bark in contrast to the papery bark of the other species covered in this book. Also, geographically, it is a southern species with very small leaves and short petioles.



Melaleuca lanceolata 1. Stand, near Beachport, S.A. [photograph courtesy of D.J.E. Whibley] 2. Fruits 3. Tree, north of Beachport, S.A. [photograph D.J.E. Whibley] 4. Seedling 5. Adult leaves 6. Fruiting branch 7. Stand, Port MacDonnell, S.A. 8. Bark, on tree north of Beachport, S.A. [photograph D.J.E. Whibley] 9. Bark, on tree near Perth, W.A. 10. Inflorescences at bud stage

Long-leaved Paperbark Broad-leaved Teatree

Melaleuca leucadendra (L.) L.

Long-leaved paperbark on good sites is a tall tree of attractive appearance with a straight trunk of good form and a distinctive white bark. On almost any favourable site the height range is 22–32 m with diameters up to about 0.6 m. It has been measured to 43 m in height and with diameters of 1–1.5 m on Cape York Peninsula, Queensland, and in such areas it is the tallest tree species. Some trees have a weeping habit with drooping branchlets, twigs and leaves.

In Australia the main distribution is along coastal areas of eastern Queensland north of Rockhampton and in the northern part of the Northern Territory, with disjunct outliers in valleys of the Hamersley Ranges in the Pilbara region of Western Australia. It also occurs in southern lowlands of New Guinea.

Long-leaved paperbark occurs mainly on flat or very gentle topography, especially river flats, coastal plains or seasonal swamps. The coastal occurrences are chiefly along the lower reaches of streams or in swampy areas with seasonally fluctuating water levels. It may form belts along some rivers 1–3 rows of trees wide. The larger and better-formed specimens grow on silty to loamy clays or sandy loams over clay. It extends also to old dune areas and even to rocky foreshores where there may be saline ground water.

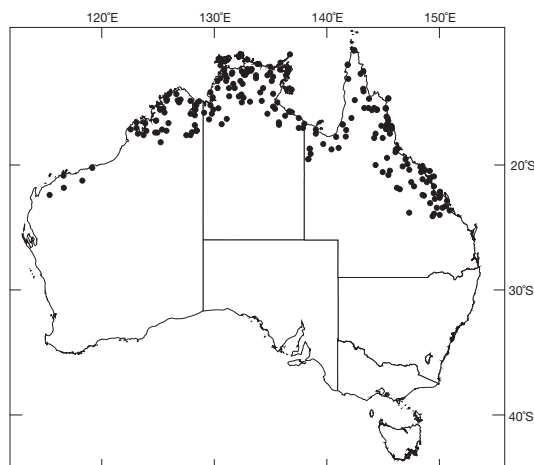
The largest trees are found in tall open forests near rainforests or occasionally in the latter. These fringing forests are often pure stands. In other areas it is usually the dominant species, both in size and in number, but may also be closely associated with melaleucas such as silver-leaved paperbark (*M. argentea*) and blue-leaved paperbark (*M. dealbata*). In other mixed stands there may be various eucalypts (e.g. *E. alba*, *E. polycarpa*, *E. tereticornis* and *E. tessellaris*) and *Lophostemon* spp. It may fringe mangrove forests or, where subsoil moisture is adequate in the drier country, may be dominant over grasses such as *Eriachne trisetia* and annual *Sorghum* species.

Related species: *M. cajuputi* can be separated by its shorter, pubescent to glabrescent leaves, *M. dealbata* by its shorter, closely and densely tomentose leaves (though the tomentum disappears with age) and *M. quinquenervia* by its leaves which are much shorter. *M. leucadendra* also has leaves which are a lighter green and thinly coriaceous.

Publication: In *Mant. Plantarum* 1, 105 (1767), based on *Myrtus leucadendra* (basionym). Previously described under the name *Arbor alba* Rumph. in *Herb. Amboin* 2, 72, t. 16 (1750), based on a figure and description of a plant from Amboin, Indonesia.

Names: Botanical—*leucadendra*, from the Greek *leuco* (white), plus *dendron* (tree), in allusion to the white bark. Common—the preferred common name is long-leaved paperbark, although the Standard Trade common name of the timber is broad-leaved teatree.

Bark: In the higher rainfall areas the larger trees have a bark which is strikingly white and feels smooth, almost slippery to



the touch. On less favourable sites the bark does not decorticate freely and there are older, slightly brownish pieces, which do not have the smooth feel of the white bark. At the base of larger trees outer layers become loose and partly unrolled when not burnt and blackened by fire.

Leaves: Cotyledons—petiolate, oval, up to 0.3×0.2 cm. Seedling—first few pairs of leaves alternate, petiolate, lanceolate, up to 7×1.2 cm, soft, flaccid, slightly hairy, conspicuously 3-veined. Adult—alternate, shortly petiolate, more or less lanceolate, $10\text{--}20 \times 1\text{--}2$ (3.5) cm, thinly coriaceous; 5 longitudinal veins (the outer pair often inconspicuous), connecting veins sometimes inconspicuous.

Inflorescences: Usually spikes, 1–3 together, terminal, or solitary in the upper leaf axils. Spikes mostly $6\text{--}15 \times 2.2\text{--}3$ cm, flowers whitish to creamy white.

Fruits: Capsules, sessile, more or less cylindrical, about $0.3\text{--}0.4 \times 0.35\text{--}0.45$ cm; thin-walled, opening very widely and valves often near rim level.

Wood: Sapwood yellowish, resistant to *Lyctus* attack; heartwood, pinkish grey, generally fine-textured, moderate strength, grain interlocked sometimes straight, durable both in water and in the ground, density $725\text{--}800 \text{ kg m}^{-3}$. The wood contains 0.2–0.95 per cent silica, which quickly blunts saws and planes. The timber does not season readily but, while difficult to plane, it glues well. Used locally in the round for house stumps, fence posts, poles and sometimes piles and mining timber or sawn for sleepers and rough construction.

Climate: Altitudinal range: near sea level to 100 (500) m; hottest/coldest months: $31\text{--}38^\circ\text{C}/9\text{--}19^\circ\text{C}$; Frost incidence: low (but some inland sites may have 1–2 per year); Rainfall: mainly 650–1500 mm per year, summer max.

Distinctive features: A tall tree with white papery bark; leaves are among the largest for the genus, 5-nerved but with the outer pair often obscure, usually widest well below the middle, light green, glabrous; inflorescences mostly glabrous, up to 20 cm long.



Melaleuca leucadendra 1. Bark 2. Adult leaves 3. Inflorescences at bud stage 4. Fruiting branch 5. Stand, near Bowen, Qld 6. Seedling 7. Fruits 8. Tree, Cairns, Qld

Preiss's Paperbark

Melaleuca preissiana Schauer

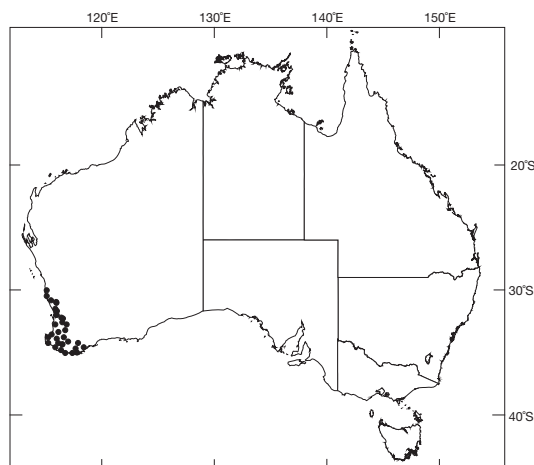
Preiss's paperbark on favourable sites is commonly a small to medium-sized tree 9–13 m tall and up to 1 m in diameter, but some may attain 15–16 m and 1.5 m diameter. The form of the tree is unusual—at 1.5–2 m height there is often a very thick ascending branch, beyond which the trunk grows obliquely and is noticeably reduced in diameter. At another 2 m or so, there is another large branch and a reduced main stem. The pattern continues giving a zigzag form. Each of the large branches tends to be ascending and carries many quite small branches and twigs with dense foliage. The overall appearance is of a number of ovoid masses of foliage at different heights. When very old trees lose most of their foliage they present a rather bizarre beauty that is very characteristic.

This species is found in coastal areas of south-western Western Australia, mainly from about 100 km north of Perth to the Albany area, but with a range from the Murchison River to near Hopetoun. It is common on flats immediately above sea level near Perth, notably in the Canning and Swan River systems, and on the moister lowland sites in the Albany–Denmark area. In places, however, it may extend about 80 km inland where soil moisture conditions are favourable.

This paperbark grows on flat or very gentle topography and shallow depressions of marshy areas. In the southern suburbs of Perth it is often found at elevations of 1–2 m above depressions or drainage channels where water may lie for several months of the year. The soils may be sandy in the upper horizons but are often silty to clayey at depth, and away from the coastal plains the heavier soils prevail, especially in ephemeral swamps. Sometimes the soils are podzolic but in such cases the species does not attain large sizes.

Vegetation types include open forests, low woodlands and tall shrublands. It is often the dominant tree species where it occurs, or there may be eucalypts present such as moitch (*E. rudis*). Although there are few large tree species in close association with Preiss's paperbark there are a large number of shrubs, especially genera of Myrtaceae and Proteaceae, which grow on the coastal plains. Among these are white myrtle (*Hypocalymma angustifolium*), which can tolerate seasonal flooding, and Swan River myrtle (*H. robustum*). Among the leptospermums the most common is swamp teatree (*L. ellipticum*). Casuarinas may also be represented.

Related species: There are only three other tree-size *Melaleuca* species in south-western Western Australia. *M. cuticularis* can be readily separated by its opposite leaves; in addition, the fruit of *M. cuticularis* is distinctive from all other Western Australian melaleucas, having prominent, out-turned persistent calyces and an overall diameter of 1 cm or more. *M. raphiophylla* has alternate leaves at an acute angle to the twigs and about 2 cm long, either terete or only slightly flattened. The fourth species, *M. lanceolata*, has leaves and



fruits which may have some resemblance to Preiss's paperbark but its bark is compact and hard.

Publication: *Pl. Preiss*, 1, 143 (1844). Type: In the Perth locality, Western Australia, J. Drummond.

Names: Botanical—honours J.A.L. Preiss (1811–1883), the distinguished German botanist who visited Western Australia in 1838–42. Common—also honours the botanist.

Bark: A typical paperbark, thin, whitish to light brownish, paper-like layers of cork, separated by thin fibrous layers, which may attain more than 5 cm in thickness.

Leaves: Cotyledons—petioles up to 0.3 cm long, cotyledons deltoid, about 0.3 × 0.3 cm. Seedling—first 1–2 pairs opposite then alternate, straplike petioles to 0.3–0.5 cm long, leaf at fourth node lanceolate, about 2 × 0.5 cm, green, glabrous, oil glands prominent, conspicuously trinerved. Adult—alternate, crowded, spreading, shortly petiolate, linear-lanceolate, flattened, 0.8–1.2 × 0.1–0.2 cm; the 3 longitudinal veins are readily visible with a ×10 hand lens.

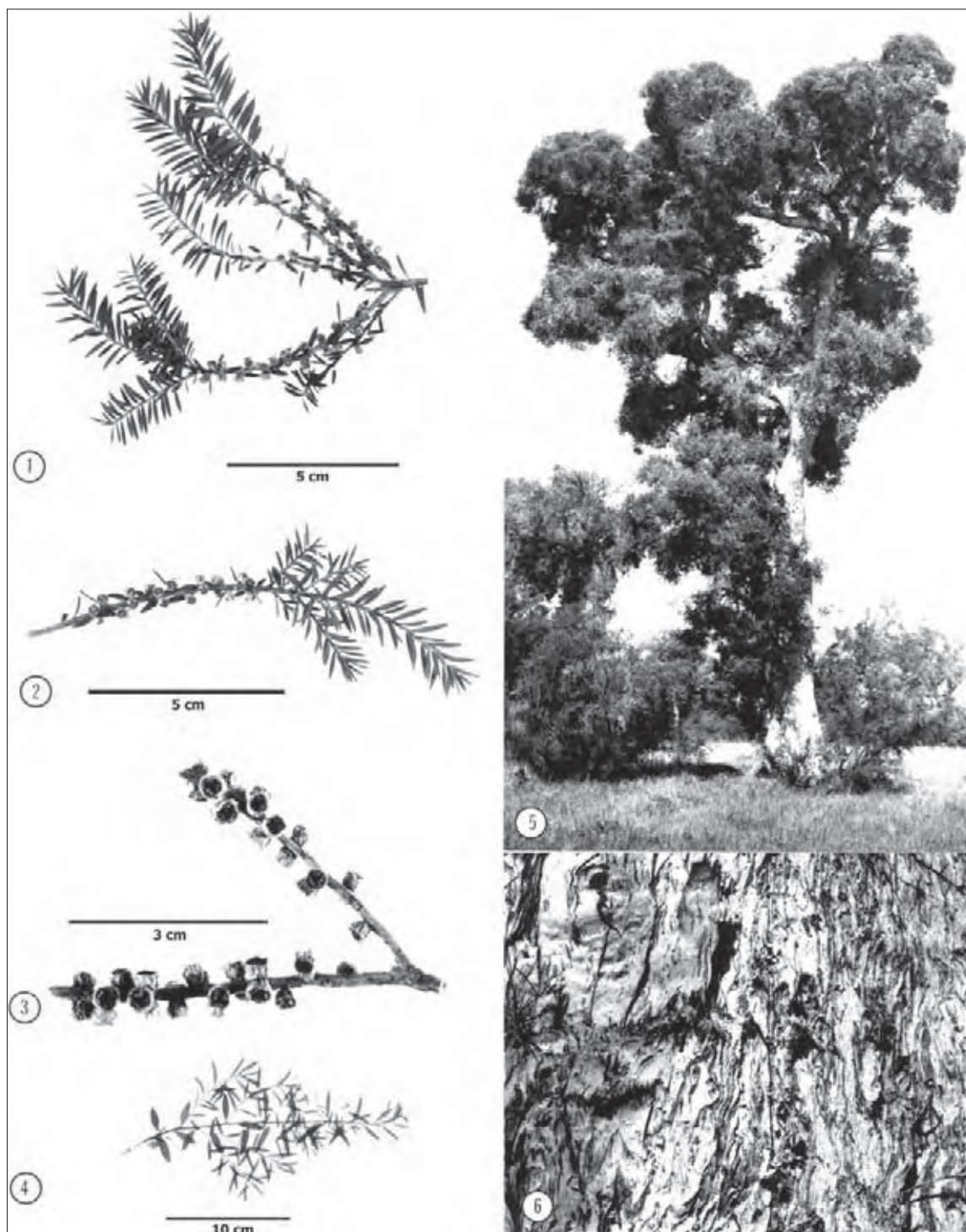
Inflorescences: Mainly in subterminal spikes, often 3–5 branched and 5–7 cm long, flowers whitish. Sometimes the flowers are solitary in the leaf axils.

Fruits: Woody capsules, subglobose to ovoid, mainly 0.25–0.35 × 0.3 cm; the opening is contracted and the valves are sunken. The calyx becomes the hard crown of the fruit which may persist for 2 years or more.

Wood: No details available.

Climate: Altitudinal range: near sea level to 100 m; hottest/coldest months: 23–30°C/8–11°C; Frost incidence: low (1–2 frosts per year in some areas); Rainfall: mainly 850–975 mm per year, winter max.

Distinctive features: Tree form, thick paperbark, alternate leaves, which are flattened and 0.8–1.2 × 0.1–0.2 cm.



Melaleuca preissiana 1. Fruiting branch 2. Adult leaves and fruits 3. Fruits after dehiscence 4. Seedling 5. Tree, near Perth, W.A. 6. Bark

Five-veined Paperbark Broad-leaved Paperbark

Melaleuca quinquenervia (Cav.) S.T. Blake

Five-veined paperbark is commonly 8–12 m in height but has a range from 4 to 5 m on dry, unfavourable sites to a tall tree occasionally 25 m high, with a moderately straight trunk, which is robust in open situations but relatively slender and with few branches in dense stands.

This species occurs mainly on the east coast of Australia, northwards from Sydney, New South Wales, to Cape York, Queensland, and usually within 40 km of the sea. Also occurs in southern New Guinea and adjacent parts of Indonesia, and New Caledonia.

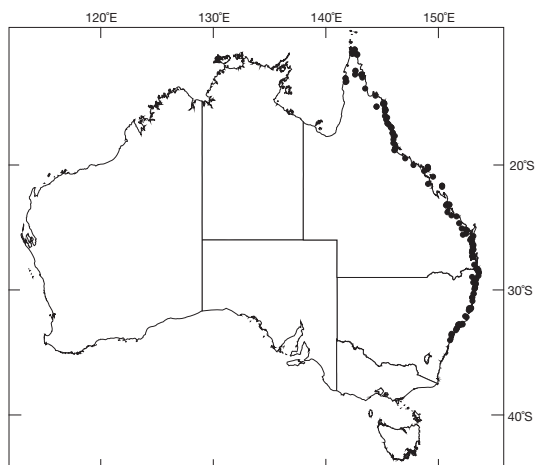
Five-veined paperbark grows along stream and estuary banks and in marshes and seasonal swamps; the topography is basically level or, at most, gently undulating. The species sometimes forms pure stands on moist coastal headlands and adjacent hills. Soils are frequently sandy in the upper layers but silty or loamy clays below; the sand may be black due to organic material. Other types include podosols and brown loams.

The tallest trees of this species are usually in swampy sites surrounded by open forests, but away from such selected areas it occurs in woodland or tall shrublands either as a dominant small tree species or as a major component of the vegetation. Where mixed with other trees, eucalypts are most common and these vary from bangalay (*E. botryoides*) at the far south of the range, to swamp mahogany (*E. robusta*) in northern New South Wales and forest red gum (*E. tereticornis*) throughout the range. Other melaleucas with which it may grow in mixture include broad-leaved paperbark (*M. viridiflora*). It is also found occupying slightly higher ground (less than 1 m) next to mangrove zones (*Rhizophora* spp.). In wet podosol soils near sea level it may be associated with ground vegetation which includes *Lomandra longifolia* and species of *Gahnia*.

Related species: Five-veined paperbark is a member of a group that includes *M. dealbata*, *M. leucadendra* and *M. viridiflora*. The leaves of five-veined paperbark are longer and soon glabrous, and the spikes longer and more open. *M. viridiflora* has leaves 2.5 cm or more wide and its petioles are 1–2 cm long and up to 0.5 cm wide. *M. dealbata* has leaves which are mostly hoary when young, with a close tomentum of minute or crisped hairs which are only lost with age. They are finely dotted and the rather open spikes may be up to 12.5 cm long. The bark of some species of *Callistemon*, e.g. *C. salignus*, is very like that of five-veined paperbark and these two are commonly confused. The two species can be readily separated since leaves of *C. salignus* have only one central vein and the new foliage is bright pinkish red in contrast to the white, hoary new foliage of five-veined paperbark.

Publication: *Proc. Roy. Soc. Qld* 69, 76 (1958). Type: Port Jackson area, New South Wales, Apr. 1793, L. Nee.

Names: Botanical—Latin *quinque* (five), plus *nervis* nerved, in reference to the common number of longitudinal veins in the leaves.



Bark: Paperbark, thin, whitish to light brownish, paper-like layers of cork, separated by thin fibrous layers and may be more than 2 cm in thickness before it finally peels off.

Leaves: Cotyledons—shortly petiolate, oval, about 0.4 × 0.2 cm, 'leaf-like'. Seedling—alternate, sessile to shortly petiolate (to 0.1 cm long), broad-lanceolate, 5–6 × 1.4–1.6 cm at node 6, stems terete and both stems and leaves sparsely covered with fine white hairs. Adult—alternate, petiolate, lanceolate to oblanceolate, more or less straight or slightly oblique, mostly 4–9 × 1.5–3 cm, coriaceous; typically with 5 longitudinal veins but range 3–7, other veins less distinct, glandular dots often obscure.

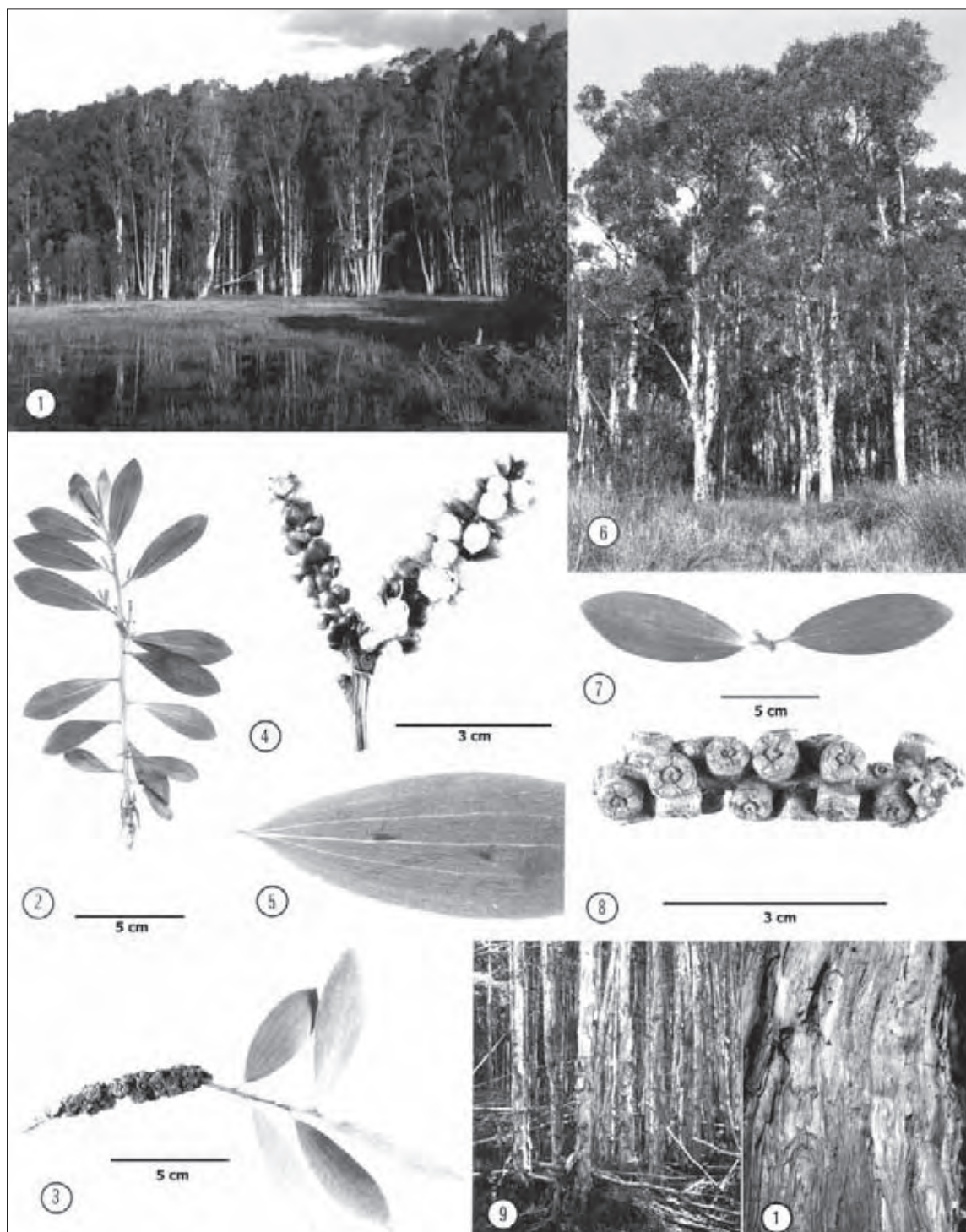
Inflorescences: Spikes, solitary or 2–3 together, terminal, sometimes singly in the uppermost 1–3 axils, densely flowered, 4–8.5 × 2.5–3.5 cm. Flowers usually whitish or creamy-white, rarely greenish or reddish.

Fruits: Sub-globoid or subcylindrical capsules, mainly about 0.4 × 0.45 cm, rather woody, with somewhat exerted valves. Fruits tend to persist up to a year.

Wood: Sapwood pinkish, resistant to *Lyctus* attack; heartwood pinkish grey, moderate strength, grain interlocked, durable both in water and in the ground, density 725–800 kg m⁻³. The wood contains 0.2–0.95 per cent silica, which quickly blunts saws and planes. The timber does not season readily but, while difficult to plane, it glues well. Used locally in the round for house stumps, fence posts, poles, mining timber and, sometimes, for small piles. It has been sawn for sleepers and rough construction. Wood is almost identical to long-leaved paperbark (*M. leucadendra*).

Climate: Altitudinal range: near sea level to 165 m; hottest/coldest months: 26–32°C/5–21°C; Frost incidence: low (but 1–5 per year in southern inland sites); Rainfall: mainly 900–1259 (2000) mm per year, mainly summer max.

Distinctive features: A tree with paperbark; leaves mostly 4–6 times longer than wide, a flattened petiole and coriaceous, with 5(3–7) principal longitudinal veins and somewhat indistinct reticulations.



Melaleuca quinquenervia 1. Stand, near Fernmount, N.S.W. 2. Seedling 3. Fruiting branch 4. Buds and flowers 5. Adult leaf venation 6. Stand, near Caloundra, Qld 7. Adult leaves 8. Fruits before dehiscence 9. Bark, young trees 10. Bark, older tree

Broad-leaved Paperbark Coarse-leaved Paperbark

Melaleuca viridiflora Sol. ex Gaertner

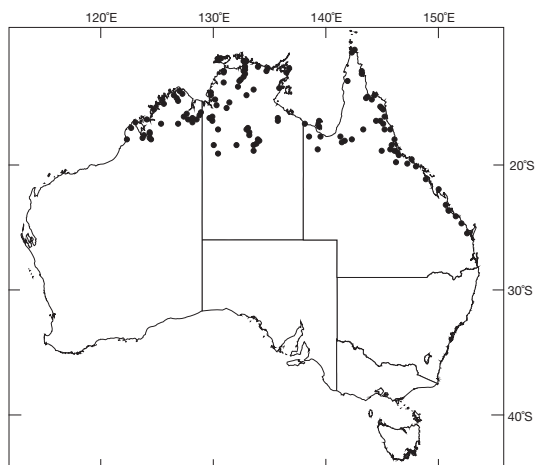
Broad-leaved paperbark varies from a straggly shrub only 1–2 m high to a slender fairly straight-stemmed, medium-sized tree up to 18 m tall. On the coastal marshes and swamplands of eastern Queensland it occurs commonly in pure stands or as the dominant species; the heights are mainly 12–15 m, with basal diameters of 0.2–0.3 m. Occasionally it grows on damp sites close to beaches, as a heavily branched, gnarled tree up to 10–12 m tall. It is usually only 4–5 m high in the vicinity of rivers flowing into the Gulf of Carpentaria.

This species occurs throughout most of northern Australia, especially in the higher rainfall areas. In Western Australia it grows in the Kimberley region and in the Northern Territory it extends to restricted sites as far south as the hotter and drier areas around Tennant Creek. In Queensland it extends southwards along the coastal plains to near Maryborough. It also occurs in the southern lowlands of New Guinea.

Typical locations for broad-leaved paperbark consist of lowland coastal marshes, seasonal swamps, estuarine plains and other areas where there is surface water for several months of the year and available soil moisture at all times. In the Kimberley region of Western Australia, the topography may be undulating and include long slopes of moderate gradient and even very small ridges. The soils of the wetter areas may be acid organic sands and loams over clay, and include sodic clays and the edges of black soils. The smaller plants, typically of shrub size and form, have been recorded on white sands, deep yellow sands, sandy loams over sandstones and micaeous granites, as well as lateritic flats and red gravels.

Broad-leaved paperbark typically occurs in woodlands, open woodlands or sometimes tall open shrublands. The stands are typically open, due to the thin canopy of such trees, with a dense cover of marsh vegetation. Where soils are somewhat drier there may be other melaleucas (e.g. *M. dealbata*, *M. leucadendra*, *M. symphyocarpa* in the east or *M. acacioides*, *M. alsophila* and *M. minutifolia* in the west). In higher rainfall areas white gum (*E. alba*) or forest red gum (*E. tereticornis*) are common associates, while in drier areas associates include bloodwoods (e.g. *E. ferruginea*, *E. foelscheana*, *E. polycarpa*, *E. ptychocarpa*), Darwin box (*E. tectifera*) and Darwin stringybark (*E. tetrodonta*), as well as species of *Xanthorrhoea*. On or near beachfronts it has been recorded with coast sheoak (*Casuarina equisetifolia*) and *Acacia mangium*.

Related species: Broad-leaved paperbark is a member of a group that includes *M. dealbata*, *M. leucadendra* and *M. quinquenervia*. Of these, broad-leaved paperbark (particularly the taller tree forms) is most often confused with *M. quinquenervia*. The two have distributions that overlap in eastern Queensland but *M. quinquenervia* typically has smaller lanceolate leaves (less than 2.5 cm in width) with somewhat obscure reticulation.



Publication: *Fruct. Sem. Pl.* 1:173, t. 35 (1788). Type: Near the Endeavour River, Queensland 1770, J. Banks and D. Solander.

Names: Botanical—Latin *viridis* (green), *flos* (flower), in allusion to the greenish white flowers which the species often has (also whitish, greenish yellow and red to crimson). Common—broad-leaved paperbark is also used for other species but is particularly applicable to this melaleuca, which has the largest and coarsest foliage of the genus.

Bark: A paperbark (thin, whitish to light brownish, paper-like layers of cork, separated by thin fibrous layers) with the outer layers often having a brownish tinge; rather coarse at the butt of large open-grown trees. The size and pattern of decorticating flakes varies widely.

Leaves: Seedling—not seen. Adult—alternate; petioles to 1 cm long and flattened; typically broad-elliptic or more or less obovate, straight and symmetrical, 6–15(22) × 2.5–6 cm, thick, coriaceous. The young shoots and leaves usually have fine silky hairs but become glabrous with age. Young and mature leaves may have a strong glaucous appearance but this often disappears early in the first year. Some races are entirely glabrous. The 5–7 longitudinal veins, as well as some of the interconnecting ones, are conspicuous.

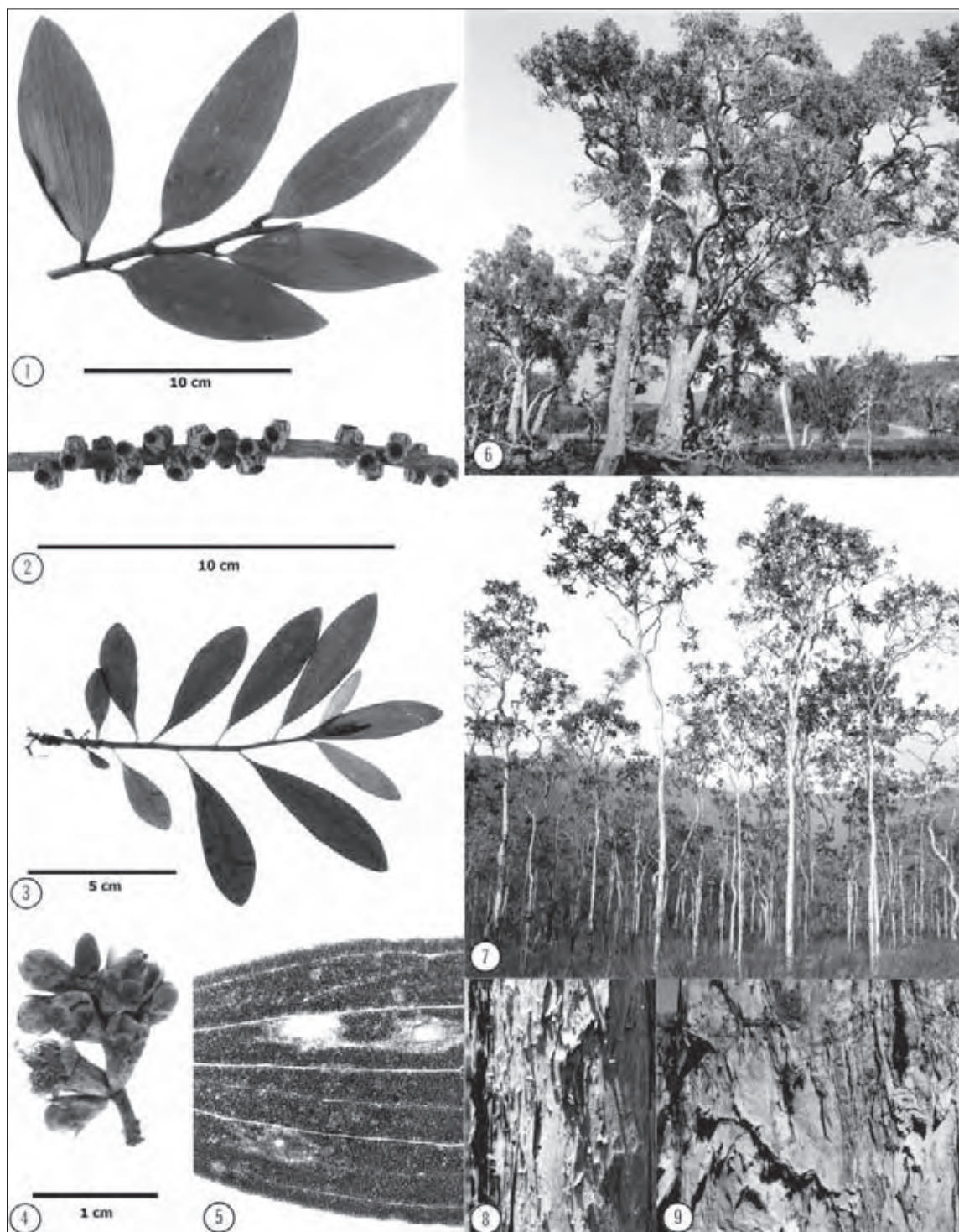
Inflorescences: Spikes, 1–3 together, mainly terminal, mostly 7–10(12) × 4–6 cm. The bundles of stamens are mainly 1.8–2.3 cm long. Growth usually continues from the end of the spikes.

Fruits: Capsules, sessile, truncate conic/cylindrical, 0.35–0.5 × 0.45–0.7 cm. Opening with the valves usually visible and just below rim level.

Wood: No details available.

Climate: Altitudinal range: sea level to 1000 m; hottest/coldest months: 29–38°C/(9–)11–16(20)°C; Frost incidence: low; Rainfall: 325–1750 mm per year, summer max.

Distinctive features: This species has the largest and coarsest leaves in the genus, as well as one of the largest flowers (stamens about 2 cm long). Both the 5–7 longitudinal veins and some of the interconnecting ones are prominent. Flowers are often greenish or sometimes red.



Melaleuca viridiflora 1. Adult leaves 2. Fruits 3. Seedling 4. Floral buds 5. Adult leaf venation 6. Trees, Emu Park near Rockhampton, Qld 7. Stand, near Ingham, Qld 8. Bark of young tree 9. Bark of old tree

Turpentine Red Turpentine, Luster (of the timber only)

Syncarpia glomulifera (Sm.) Nied.

Turpentine is a large tree, usually 40–45 m tall and 1–1.3 m in diameter, but attaining 55 m in height and over 1.5 m in diameter on optimum sites. The largest tree in New South Wales is 60 m tall and 1.66 m in diameter. The trunk is straight, of good form, with little taper and up to two-thirds of the tree height. Open growing trees tend to coppice along the stem producing trees with long, narrow crowns. There are two subspecies.

Subspecies *glomulifera* occurs along the eastern coast of Australia from near Batemans Bay, New South Wales, to near Atherton in northern Queensland. The main distribution is between Batemans Bay and Gympie with disjunct isolated stands occurring farther north on the Blackdown and Consuelo Tablelands, in the Tinnaroo area near Atherton and on the Windsor Tableland. Subsp. *glabra* extends north from Bulahdelah to Kempsey on the central coast of New South Wales.

Turpentine has its best development in valleys, on flats and in basins in locations varying from coastal lowlands to mountains and tablelands. While it may also occur on ridges and other exposed situations it does not develop good form in such localities. It prefers deep, fertile soils but grows on a wide range, including moderately poor soils derived from sandstone.

This species is most common in mixtures forming a transition between rainforest and eucalypt forest. Under these conditions it may be associated with flooded gum (*Eucalyptus grandis*), tallowwood (*E. microcorys*) and brush box (*Lophostemon confertus*), as well as various rainforest species. Also fairly common in spotted gum (*E. maculata*)—blackbutt (*E. pilularis*) forests.

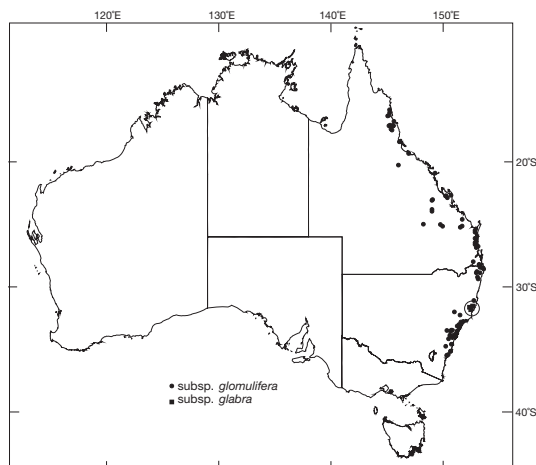
Related species: There are three species of *Syncarpia*, all endemic to Australia. Bean (2005) revised this group.

Publication: Subsp. *glomulifera*: Engl. et Prantl. Nat. Pflanzfam. iii, 7 (1893). Type: Port Jackson, New South Wales, D. Burton. Subsp. *glabra* (Benth.) AR Bean: *Austrobaileya* 4, 339 (1995). Type: Hastings River, New South Wales, Dr. Beckler s.n.

Names: Botanical—*Syncarpia*, Greek *syn* (with, together), *carpos* (fruit), alluding to an aggregated fruit with united carpels; *glomulifera*, Latin *glomus* (ball), *fer* (to carry), referring to a compact cluster of floral parts; Latin *glabra* (without hair) refers to the lack of indumentum. Common—presumably to the resin that flows from cut twigs.

Bark: Persistent over the trunk and branches, thick, fibrous and stringy with deep longitudinal furrows, brown or reddish.

Leaves: Seedling—opposite, shortly petiolate, elliptical, 3–6.5 × 0.8–2 cm, undersurface of leaves and on the young stems hairy (*glomulifera*) or glabrous (*glabra*). Adult—opposite pairs, grouped in fours to appear as whorls; petioles to 0.7–1.3 cm long; ovate or broadly elliptical, 7–10 × 2.5–4.5 cm, dark dull green above, undersurface covered with white or pale brown finely matted hairs (*glomulifera*) or glabrous (*glabra*). The leaves are thick and stiff with leaf edges tending to be recurved. The spring foliage is very hairy being covered in long



simple hairs and shorter crisped hairs. Resting buds consist of several pairs of linear bracts up to 2.5 × 0.5 cm. Twigs exude a clear reddish liquid when cut.

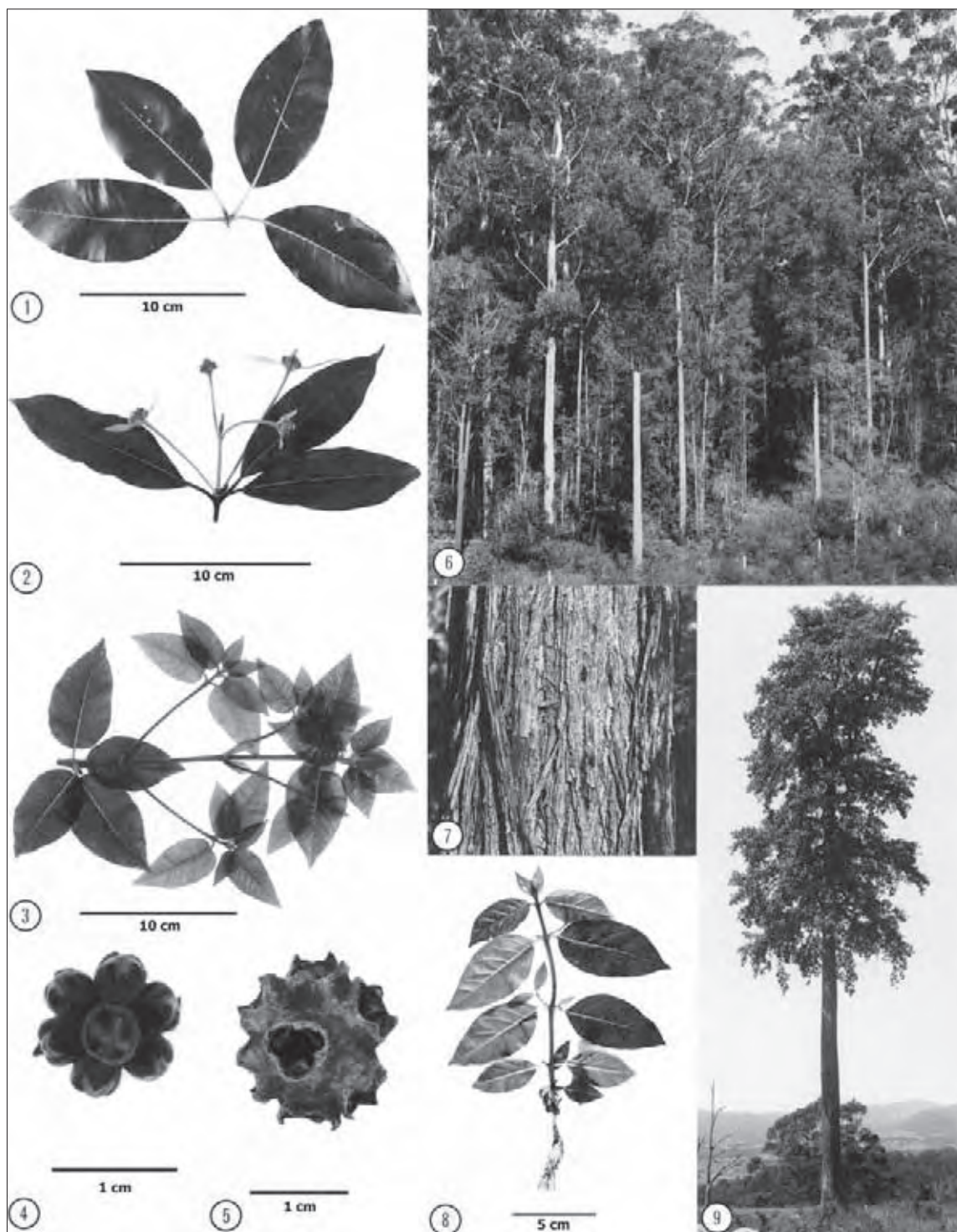
Inflorescences: Axillary, usually in 1–2 whorls of 4 inflorescences. In each inflorescence the bases of the floral tubes are united forming a compound structure on a short peduncle 2.5–5 cm long. Usually 7 flowers in each head. Sepals usually 4–5, short, triangular, persistent. Petals 4–5, very hairy, white or cream, free, ovate, 0.5–0.8 cm broad, deciduous. Stamens numerous, much longer than the petals, 0.8–1 cm long, free, usually arranged in two whorls. Ovary inferior, 3-locular with numerous ovules per loculus. Style single, straight and slender with a few simple hairs at its base. Base of nectary has 3 grooves. Hypanthia either hairy (*glomulifera*) or glabrescent (*glabra*). Flowers spring–summer.

Fruits: Three-locular capsules fused into a mass of 7 fruits, 1–2 × 1.5–2 cm, hard and woody, with persistent calyx lobes about 0.1–0.2 cm long. Numerous ovular structures are produced per loculus. Seeds small, elongated and angular.

Wood: Sapwood resistant to *Lyctus* attack; heartwood red to reddish-brown similar to brush box (*Lophostemon confertus*), fine and even in texture, grain usually interlocked, hard, strong, durable, density 700–1005 kg m⁻³. The timber is highly resistant to decay, termites and attack by marine organisms. The timber is difficult to ignite and among the world's most resistant timbers to damage by fire. It has a high shrinkage which can be reduced by reconditioning. Because of its durability turpentine is a pre-eminent Australian timber for structural purposes such as piles (with bark retained), poles, girders, beams, wharf decking and heavy duty floors. Wood is also similar to satinay (*S. hillii*).

Climate: Altitudinal range: near sea level to less than 300 m (NSW) or to 900 m (Qld.); hottest/coldest months: 26–30°C/5–10°C; Frost incidence: low to moderate (upland sites receive 5–20 per year); Rainfall: 1000–2000 mm per year, summer max. in the north to uniform in the south of its range.

Distinctive features: A large tree with thick, fibrous bark and fused woody fruits derived from 7 flowers fused into a single head; leaves whorled, strongly discolourous.



Syncarpia glomulifera 1. Whorl of four adult leaves 2. Four inflorescences 3. Leaves from sapling 4. Buds of an inflorescence 5. Fruits fused together 6. Two turpentine trees in foreground with blackbutt (*Eucalyptus pilularis*) in background, near Nambucca Heads, N.S.W. 7. Bark 8. Seedling 9. Isolated tree on farmland, near Nowra, N.S.W.

Grey Satinash Watergum

Syzygium gustavioides (F.M. Bailey) B. Hyland

Grey satinash is a medium-sized to tall tree attaining 40 m in height and 1.8 m in diameter. The buttresses at the base of trees often take the form of 'flying-buttresses' which develop from adventitious roots.

This species has a limited distribution in northern Queensland between Tully and Cooktown.

Soils are usually deep loams on a variety of rock types but trees reach best development on basalt.

Grey satinash grows in a variety of well-developed rainforest types and is associated with a large number of rainforest tree species.

Related species: Hyland (1983) revised the genus *Syzygium* in Australia and recognised over 50 species. Grey satinash, formerly *Eugenia gustavioides*, is not closely related to any other species.

Publication: *Aust. J. Bot. Supp. Ser.* 9, 93 (1983). Type: Lake Barrine, near Atherton, northern Queensland, J.F. Bailey.

Names: Botanical—*Syzygium*, from the Greek *suzugos* (joined), because of the paired leaves and branchlets, which are similar to a Jamaican species (*Calyptranthes syzygium*); *gustavioides*, resembling the fruit of *Gustavia* (Lecythidaceae). Common—alludes to the greyish wood, which is intermediate in properties between the satinwoods and ashes.

Bark: Flaky, orange-brown or pinkish brown. The outer blaze is brown (rarely cream) and fibrous.

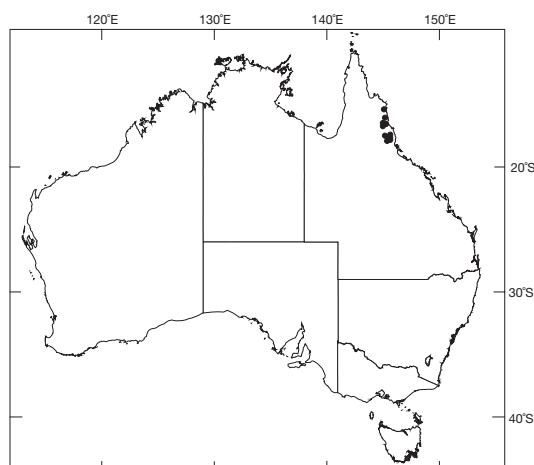
Leaves: Cotyledons—hemispherical, cryptocotylar.

Seedling—first 5–7 pairs are cataphylls which are opposite, subopposite or alternate, subsequent leaves are opposite, subopposite or alternate, short petioles about 0.2–0.5 cm long, simple, entire, elliptical, 2.5–6 × 1.2–1.3 cm, glossy green above, discolorous, glabrous; venation reticulate, numerous oil glands present. Adult—opposite, petioles about 0.5–1.8 cm long, simple, elliptical, often mucronate, 6–14.5 × 2.5–7 cm, margins often recurved, leaf blades often V-shaped in cross-section; lateral veins, 6–12 pairs, amalgamating and forming a conspicuous inner intramarginal vein about 0.4–1.2 cm from the edge of the leaf blade; a second intramarginal vein occurs closer to the margin; oil dots numerous.

Inflorescences: Terminal and in the upper axils, paniculate. Calyx calyptrate, petals 4 but small (0.2–0.3 × 0.1–0.2 cm), inconspicuous, often attached to the underside of the operculum and shed with it. Stamens numerous. Ovary 2-celled, 4–8 ovules per locule. Style about 0.4–0.7 cm long, approximating the length of the stamens. Flowers Feb.–Dec.

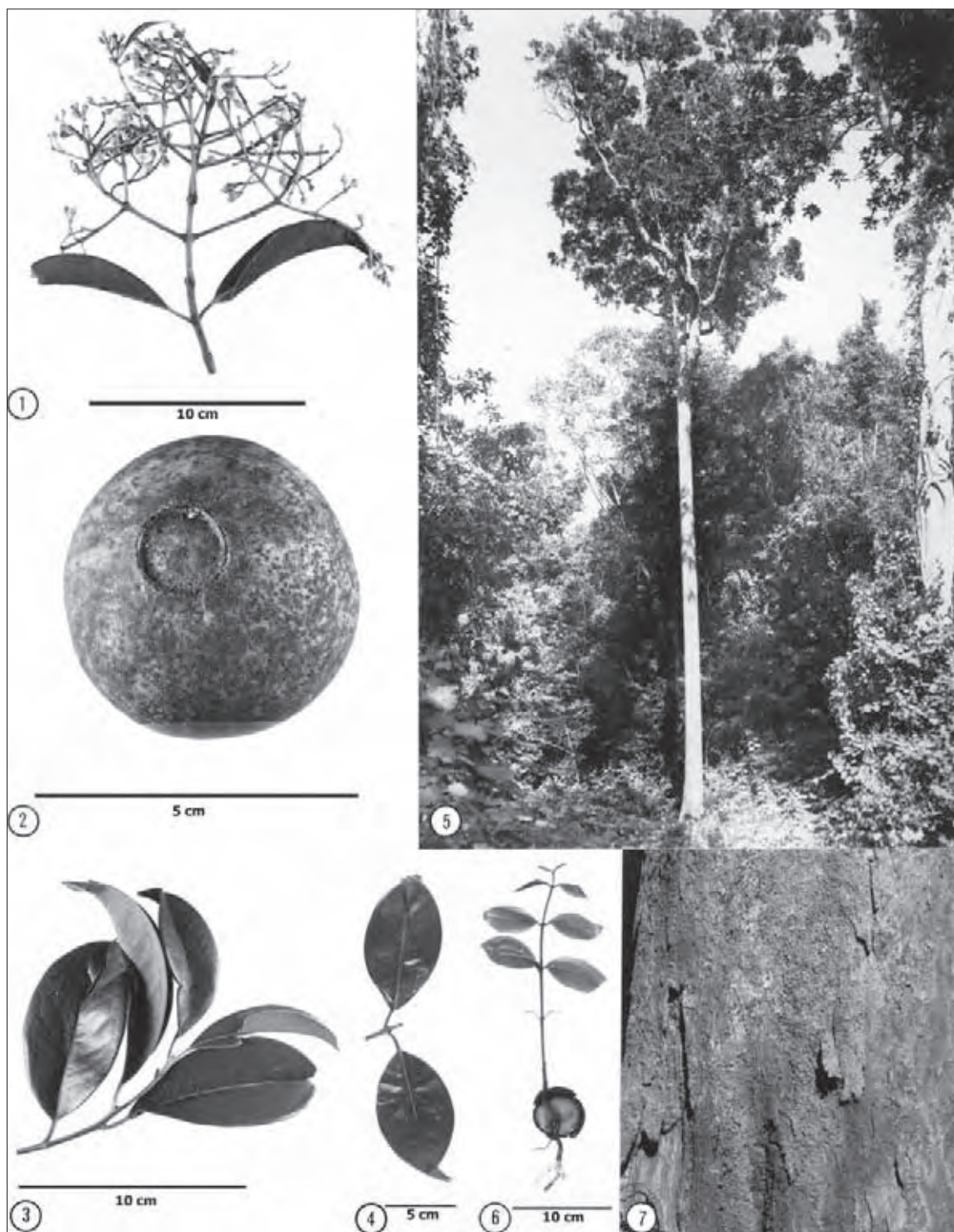
Fruits: Each a drupe, often falling while still greenish but ripening greenish brown, reddish brown or pinkish grey, globular, attaining 6 cm diameter, with a tonsure-like section at the apex. Calyx lobes absent. Pericarp leathery. Seed attaining 5 cm in diameter.

Wood: Sapwood susceptible to *Lyctus* attack; heartwood yellow to yellowish grey, uniform and medium texture, durable when exposed to the weather but not when in contact with the ground, density 460–835 kg m⁻³. A popular and reliable building timber; it can be used for framing, dressed window and doorsills, joinery and flooring. Has potential for furniture as it shows an attractive figure on backsawn faces.



Climate: Altitudinal range: near sea level to 1200 m; hottest/coldest month: 30–32°C/13–19°C; Frost incidence: low; Rainfall: 1400–3800 mm per year, summer max.

Distinctive features: Stem with buttresses, often flying buttresses at the base, orange-brown bark, brown fibrous blaze, leaves with 2 intramarginal veins, calyptrate calyx, large fruits with tonsure-like scar at the apex.



Syzygium gustavioides 1. Inflorescence 2. Fruit 3. Adult leaves 4. Pair of adult leaves 5. Tree, Boonjie State Forest, south-east of Atherton, Qld 6. Seedling with seedcoat near base 7. Bark

Forest Satinash Apple, Lady Apple

Syzygium suborbiculare (Benth.) T.G. Hartley & L.M. Perry

Forest satinash is usually a small tree attaining a height of 12 m and occasionally reaching 0.8 m diameter. The stem is not buttressed at the base.

This species has a wide distribution in northern Australia, occurring on Cape York Peninsula, the Northern Territory and the Kimberley region of Western Australia. It also occurs in southern New Guinea.

Soils generally consist of sandy strongly leached profiles of low fertility.

Forest satinash occurs in open forests, beach forests and woodlands. It is associated with a number of tree species, some of the more common being Darwin stringybark (*Eucalyptus tetradonta*), northern woollybutt (*E. miniata*), Melville Island bloodwood (*E. nesophila*), nonda (*Parinari nonda*) and *Melaleuca* spp. in open forest communities, while in other communities they include beach sheoak (*Casuarina equisetifolia*), *Syzygium banksii*, *Diospyros* sp., wattles (*Acacia crassicaarpa*, *A. oraria*), red coondo (*Mimusops elengi*), *Manilkara kauki*, cluster fig (*Ficus racemosa*), tulip plum (*Pleiogynium timorense*) and *Terminalia muelleri*.

Related species: There are over 50 species of *Syzygium* in Australia (Hyland 1983). Forest satinash sometimes difficult to distinguish from the sympatric *S. eucalyptoides* but is most closely related to *S. alliligneum* and *S. velae*, which grow in the rainforests of north-eastern Queensland.

Publication: J. Arnold. *Arbor.* 54, 189 (1973). Type: syntypes from Cape York, Queensland, W. Hill 136 and Endeavour River, Queensland, W. Hill 41.

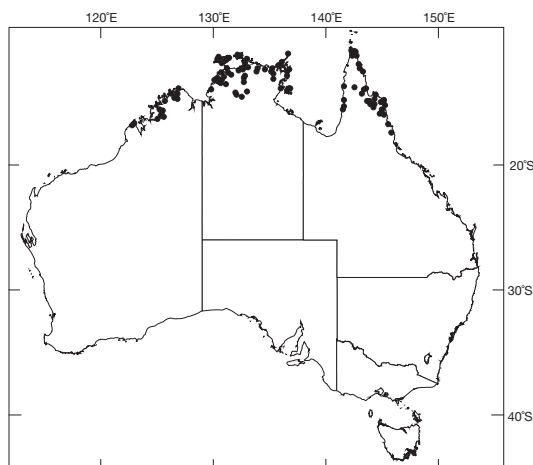
Names: Botanical—*Syzygium*, from the Greek *suzugos* (joined), because of the paired leaves and branchlets, which are similar to a Jamaican species (*Calypttranthes syzygium*); *suborbiculare*, from the Latin *sub* (almost), plus *orbiculare* (round and flat), in allusion to the almost circular leaves on some forms of this species. Common—refers to the fact that the wood is intermediate in properties between satinwoods and ashes.

Bark: Flaky or nondescript, outer blaze red or brown with longitudinal stripes, granular in texture.

Leaves: Cotyledons—hemispherical, cryptocotylar.

Seedling—cataphylls 3–5 pairs, opposite or subopposite, later leaves mostly opposite; petioles 0.3–0.7 cm long; elliptic-oblongate, about 6–14 × 2–3 cm, glabrous, entire, shiny green above, dull beneath; venation more or less penninerved, visible both surfaces, intramarginal vein about 0.1 cm from leaf margin. Seedling often multi-stemmed and lignotuber usually well developed. Adult—opposite; petioles 0.7–3.4 cm long; shape varying from orbicular, oblong, ovate, elliptical, lanceolate, 7–19 × 4–13 cm, more or less concolorous. Lateral veins about 12–27 pairs, intramarginal vein (sometimes 2) generally well developed; oil-dotted.

Inflorescences: Usually terminal, sometimes also in the upper axils, cymose, racemose to almost umbellate by reduction. Flower buds turbinate, pyriform, obovate. Flowers cream, 4-merous, calyx tube plus pedicel 1.4–3 × 0.8–1.8 cm. Calyx more or less semicircular, 0.6–1.5 cm long. Petals more or less circular to transversely oblong, 1.2–2.4 × 1.2–2 cm.



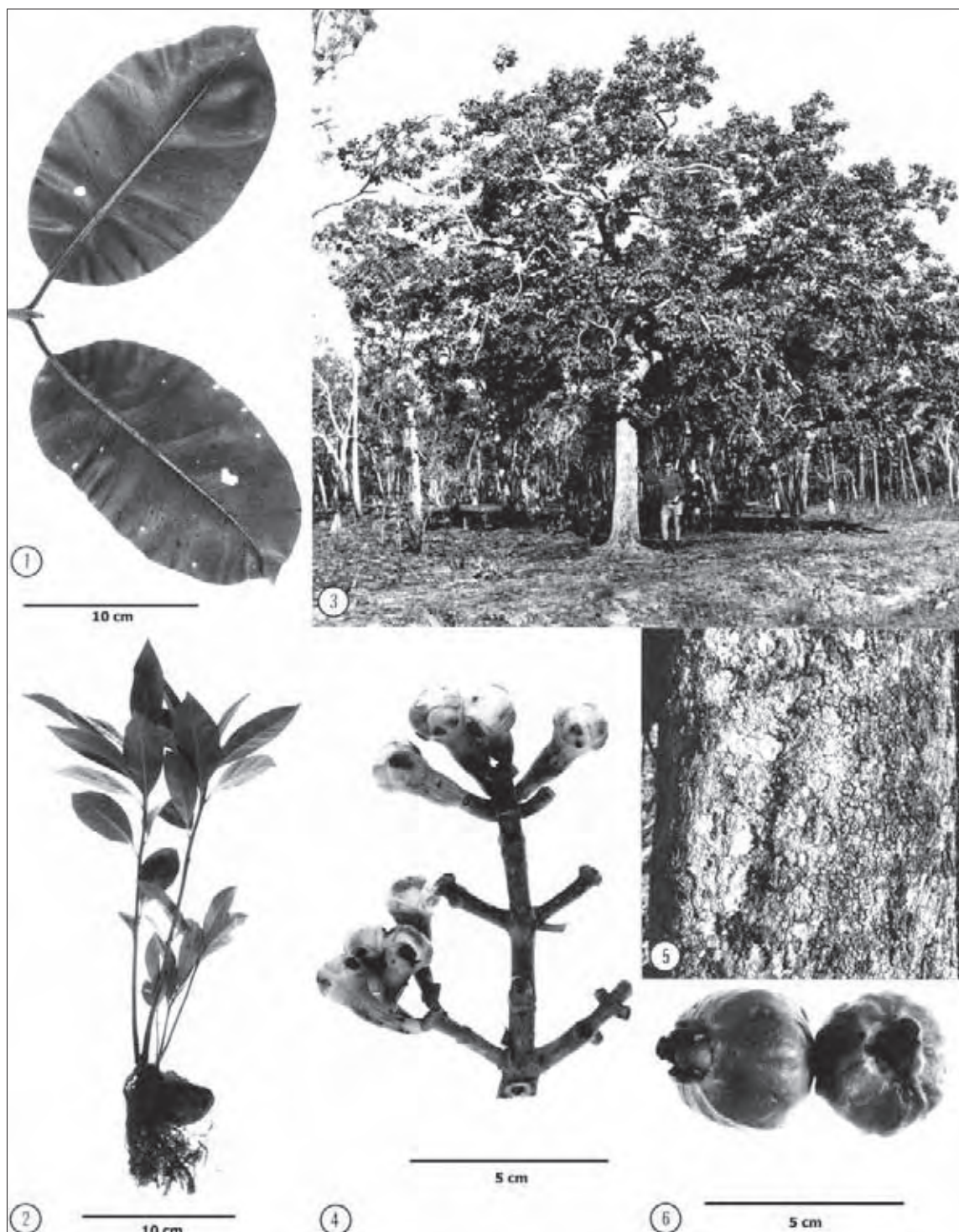
Stamens very numerous, filaments 1.8–4.5 cm long, anthers 1.1–2.1 × 0.4–0.7 mm. Ovary 2-celled with 25–65 ovules per cell. Style 2–5.5 cm long, approximating or exceeding the stamens in length. Flowers Jun.–Nov.

Fruits: Drupes, red or reddish, depressed globular to ovoid, 3–7 × 3.5–9 cm, pericarp succulent but somewhat fibrous near the seed, calyx lobes persistent, 0.6–1.3 cm long. Seed solitary, about 3–5.5 cm diameter. Fruits edible.

Wood: Sapwood susceptible to *Lyctus* attack; heartwood pale pinkish brown or pale grey-brown, density 770 kg m⁻³, with incomplete bands of included phloem (bark) making conversion to sawn timber a challenge.

Climate: Altitudinal range: near sea level to 220 m; hottest/coldest month: 31–38°C/12–22°C; Frost incidence: low; Rainfall: 950–1750 mm per year, summer max.

Distinctive features: Small to medium-sized, poorly formed tree, leaves opposite, oil-dotted, broad almost orbicular; flowers large, cream, stamens numerous; fruits red and succulent. Sections of bark are included in wood of stem.



Syzygium suborbiculare 1. Pair of adult leaves 2. Seedling illustrating multi-stemmed habit 3. Tree, beside Archer River, northern Qld 4. Inflorescence with floral buds 5. Bark 6. Mature fruits

Banksias

The generic name *Banksia* was given by the younger Linnaeus in honour of Sir Joseph Banks (1743–1820). It was Banks who collected the first specimens of *Banksia*, viz. *B. serrata*, *B. ericifolia* and *B. integrifolia* at Botany Bay, New South Wales, and also *B. dentata* at the Endeavour River, Queensland, in 1770 during Captain James Cook's voyage to Australia. Banksias are also known as honeysuckles because of the copious quantities of nectar produced by the flowers.

There are 76 species of *Banksia* and with the exception of the tropical *B. dentata* (whose occurrence extends to Papua New Guinea and Aru, Indonesia) they are found only in Australia. Banksias occur in all States but they are most abundant in Western Australia where there are 60 endemic species. Banksias vary in size from small prostrate shrubs less than 0.5 m tall, e.g. *B. repens*, to medium-sized trees some 15 m tall, e.g. *B. integrifolia*. Some species are capable of producing lignotubers (e.g. *B. sphaerocarpa*), others are non-lignotuberous (e.g. *B. ericifolia*) and a few produce root suckers (e.g. *B. integrifolia*). Banksias occur from sea level to at least 1500 m altitude and they generally prefer poorer quality acidic soils although some occur on limestone in Western Australia. Some species prefer moist swampy sites, e.g. *B. robur*, while others prefer dry rocky ridges, e.g. *B. oblongifolia*.

The *Banksia* inflorescence is a terminal spike, usually held erect, and consists of perhaps 1000 or more flowers. A typical *Banksia* flower, e.g. in *B. integrifolia*, consists of sessile flowers arranged in pairs around the thick woody rhachis of the spike, with each pair subtended by one thick bract (the common bract) plus two floral bracts. The perianth tube is very slender and consists of four tepals with four sessile anthers seated in little depressions near the top of each tepal. The

style is usually much longer than the perianth tube and is very wiry. The ovary is superior and 1-locular. The top of the style is held captive by the upper perianth parts but the middle section of the style usually arches out from the flower through a slit in the perianth tube. The styles of flowers in *B. integrifolia* (and most *Banksia* spp.) are released sequentially from the bottom of the inflorescence to the top over a period of days but in a few species, e.g. *B. ericifolia*, they are released from the top down. The released style is finally straight in *B. integrifolia* but the upper part is hooked in a few species, e.g. *B. ericifolia*.

The often brilliant colours of a *Banksia* inflorescence are determined by the colour of the perianth parts and often the style. The styles of *B. ericifolia* are bright orange-red and in *B. coccinea* the styles are striking scarlet in colour and when in season the inflorescences of the latter are gathered and sold for cut-flower displays. In *B. spinulosa* the yellow perianth parts (some forms are gold or red) are enhanced by the purple-black colour of the style.

Banksias are easily recognised in Australian forests because of their large persistent fruiting structures. Despite the large size and the huge number of flowers per spike only a small percentage of the flowers actually develop into fruits which are called follicles. These consist of two horizontally disposed woody valves which tightly enclose usually two, small, papery winged seeds. The fruits usually require intense heat, such as that provided by passing bushfires, to open them but in some species the seeds are released when the fruits are mature, e.g. *B. integrifolia*. The seeds are released with a small wedge-shaped structure (the separator), which bears one seed on either side. Surrounding the follicles are the withered remains of the perianth parts and styles.

These are persistent and most distinctive in *B. serrata* and are the legendary 'Banksia men' portrayed in the delightful children's stories by May Gibbs. In some species the perianth and style are deciduous, e.g. *B. menziesii*.

The leaves of banksias are alternately arranged but may be crowded into 'whorls' as in *B. integrifolia* var. *integrifolia*. Leaf sizes vary from the small heath-like foliage of *B. ericifolia* with narrow leaves about 1–1.5 cm in length to the long broad leaves, up to 45 cm in length, of *B. grandis*. The edges of the leaves of most banksias are characteristically very serrate. Leaf serration is extreme in *B. baxteri* but a number of species have adult leaves with smooth edges, e.g. *B. integrifolia*. In *B. spinulosa* the lateral edges are mostly smooth but the end of the leaf has three spiny tips.

The genus *Banksia* consists of two subgenera *Banksia* and *Isostylis* (George 1981, George 2000). The latter subgenus contains three closely related species, endemic to Western Australia, viz. *B. ilicifolia*, *B. cuneata* and *B. oligantha*, and these have abbreviated head-like inflorescences with follicles curved laterally. The 73 remaining species belong to subgenus *Banksia*, which is subdivided into three sections, viz. *Banksia* (50 species), *Oncostylis*

(21 species) and *Coccineae* (one species, *B. coccinea*). All species of section *Banksia* have straight styles in contrast to all species in section *Oncostylis* which have hooked styles and section *Coccineae* where the style is looped horizontally. There are differences in features such as cotyledons but these are not quite as clear-cut. Section *Banksia* is divided into nine series and section *Oncostylis* into four series, all based on a variety of characters. All except two species in section *Banksia* have inflorescences opening from the base upwards, while all except one in section *Oncostylis* open from the top downwards.

Most regional keys to *Banksia* species are based on the morphology and size of leaves and fruits. The style shape (either hooked, straight or looped horizontally after release) and details of floral colour and tree form are also very important, as is the presence or absence of a lignotuber.

Banksias are valued as ornamentals for their foliage shapes and floral colours. They can also be grown on very poor sites and hence are of some environmental value. The nectar and pollen are also sought by beekeepers. The wood is of little value but has been used for ornamental purposes, firewood and small boats.

Bull Banksia Giant Banksia

Banksia grandis Willd.

Bull banksia is probably the most conspicuous banksia in Western Australia. It is usually a tree between 5–10 m in height with a trunk 0.25–0.5 m in diameter, but it can attain heights of up to 15 m. Trees usually have short, stout, often crooked boles and wide, open, spreading crowns but where trees occur in dense stands they are rather spindly with narrow, erect crowns. They also occur as very stunted trees among granite rocks and on wind-swept hills overlooking the southern ocean. New foliage is conspicuously reddish brown and the species is capable of epicormic growth. The species is lignotuberous.

This species occurs in Western Australia from south of Toodyay and Wanneroo down the west coast and the plains and plateaux around to Albany and Cape Riche. Small isolated populations occur to the north beside Mt Lesueur and to the east near Woodanilling about 150 km from the coast.

Bull banksia commonly occurs on lateritic podzolic soils of the Darling Range. The species also occurs on wet sandy soils in the karri (*Eucalyptus diversicolor*) forests and on the coastal sandy plains with their yellow siliceous and also pale-coloured calcareous sands.

Bull banksia forms a conspicuous understorey tree in eucalypt forests especially under open forests of jarrah (*E. marginata*) and also under the tall open forests of karri. It is commonly the only banksia present in the marri (*E. calophylla*) and jarrah forests. On the coastal plains giant banksia is associated frequently with sheoak (*Allocasuarina fraseriana*) but also with tuart (*E. gomphocephala*) and other banksia species. The Woodanilling population is unusual in that it occurs farther east than the main *B. grandis* occurrence and, because the species occurs in a tall shrubland on sandy soils, its associates include Western Australian Christmas tree (*Nuytsia floribunda*) and coast banksia (*B. attenuata*).

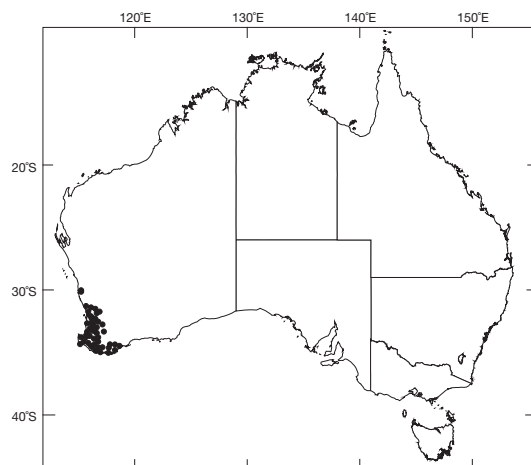
Related species: Bull banksia is closely related to *B. solandri*. The latter species is a slender-stemmed shrub up to 5–6 m tall; leaves have fewer and more rounded lobes; flowers are hirsute, purplish brown in colour and the perianth parts are more persistent than those of bull banksia.

Publication: *Spec. Pl.*, edn 4, 535 (1798). Type: From a cultivated specimen in Berlin, Germany, probably from seed collected by Archibald Menzies.

Names: Botanical—Latin *grandis* (great, large, tall), alluding to the large size of this banksia. Common—indicates the gross size of this species compared with most other banksias.

Bark: Young bark on saplings is soft and rubs off with a talc-like feel. Older bark is hard, granular and rather knobby.

Leaves: Seedling—alternate, petiolate (about 1–1.5 cm) and slightly winged, obovate, 5–15 × 2–7 cm, 5–7 triangular segments each side of the leaf each ending in an abrupt point, green above and lighter green below, softly hairy; secondary veins parallel with fine rectangular veins between. Adult—alternate, petiolate, obovate, 20–50 × 4–8 cm, shiny dark



green, deeply divided almost to the midrib into large triangular pieces with the wide base of each lobe overlapping the preceding one near the leaf midrib. The undersurface of the leaf is covered with a soft white tomentum.

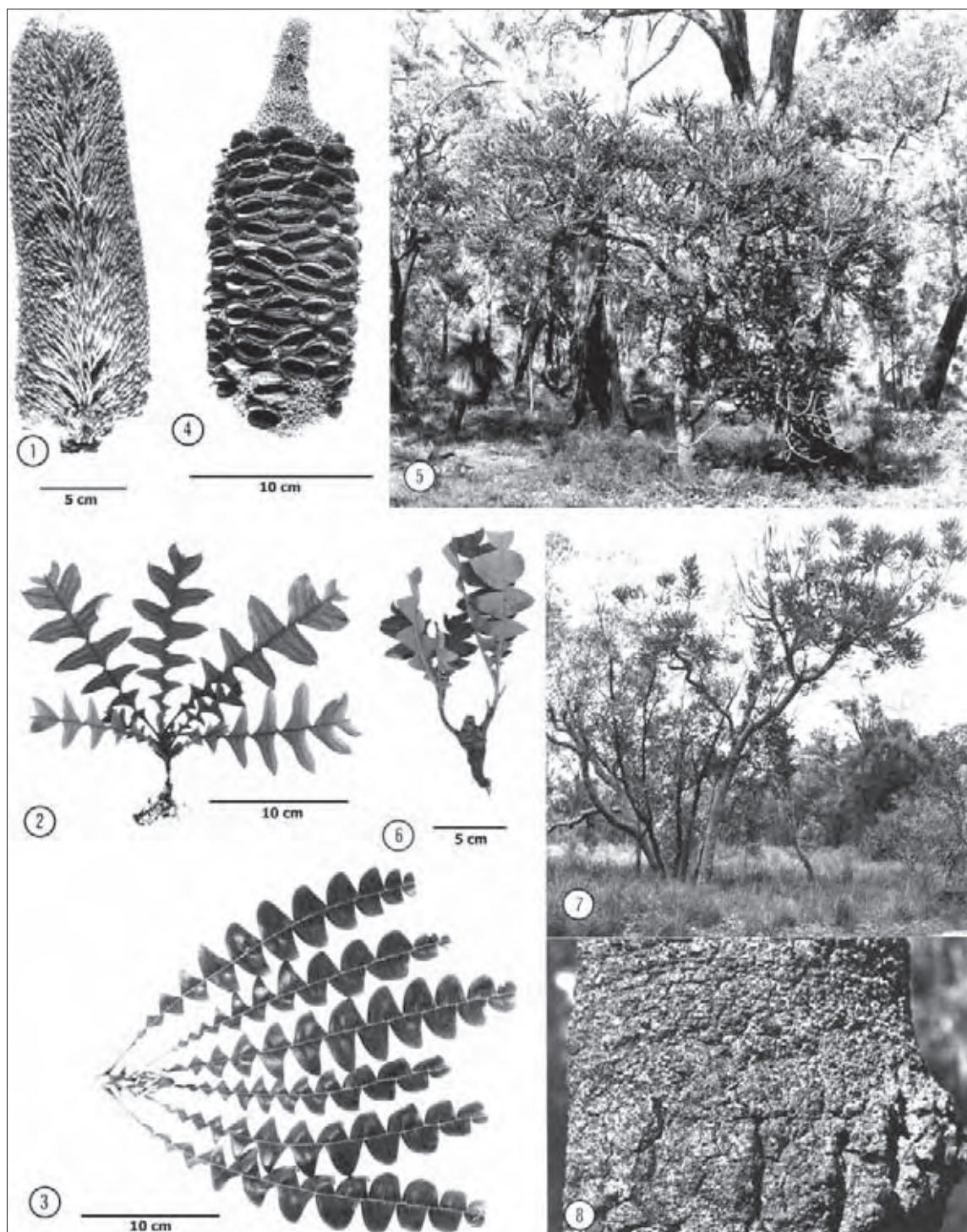
Inflorescences: Floral spikes, upright, cylindrical, 25–40 × 10–15 cm. The unopened flowers are metallic green while the open flower is golden yellow. Styles long and slightly curved at the end but not hooked, released from the base upwards. Flowers Sept.–Nov. and on the south coast between Augusta and Albany Sept.–Jan.

Fruits: Spikes oblong, cylindrical, about 7 × 18 cm and often with a narrow dome at the apex where the seed follicles have failed to develop. Follicles relatively thin-walled about 2 cm wide and dehisce spontaneously. A high percentage of the seeds in the follicles are destroyed by insects.

Wood: Similar to the wood of other species of *Banksia* but with mostly larger rays than in other species.

Climate: Altitudinal range: near sea level to 300 m; hottest/coldest month: 23–29°C/4–9°C; Frost incidence: low to moderate (inland sites 10–20 per year); Rainfall: 650–1300 mm per year, winter max.

Distinctive features: An understorey species occurring in jarrah forests, with large deeply divided leaves and large erect fruits.



Banksia grandis 1. Inflorescence at bud stage 2. Seedling 3. Adult leaves 4. Fruit after dehiscence 5. Stand, Darling Range, near Perth, W.A. 6. Field seedling indicating lignotuber-like structure 7. Tree, Kings Park, Perth, W.A. 8. Bark

Coast Banksia

Banksia integrifolia L. f.

Coast banksia is one of the tallest banksias on the east coast of Australia, forming medium-sized trees to 16 m in height and 0.5 m in diameter. Tree boles are usually twisted and gnarled and the branches are often grotesque and contorted. This is usually caused by wind, and such trees are common close to the coast where the species may even be reduced to small shrubs as on exposed coastal headlands. The species is lignotuberosus. The tree crowns are dark green with the white undersides of leaves becoming conspicuous during light breezes. Individual trees are also notable for the occurrence of erect persistent old fruits, which are numerous, small and white or grey and devoid of persistent old flowers—a characteristic that is common in some other banksias.

Coast banksia consists of three subspecies, the typical subspecies, subsp. *compar* and subsp. *monticola*. Subsp. *integrifolia* typically occurs near coastal cliffs and headlands, river estuaries and near sand dunes along the east coast of Australia from near Melbourne, Victoria, to near Tin Can Bay, Queensland. A small isolated population occurs on Long Island (Hogan Group), Tasmania. Subsp. *compar* occurs in coastal areas between Proserpine to Wide Bay, Queensland. Subsp. *monticola* is endemic to New South Wales between New England National Park and Mount Wilson in the Blue Mountains.

Coast banksia is found on well-drained soils, heavy clay soils, occasionally on sandstone soils near the coast and soils derived from granites and basalts. Also occurs on stabilised sand dunes near beaches.

Coast banksia can occur in pure stands in open forests, associated with a very wide range of species.

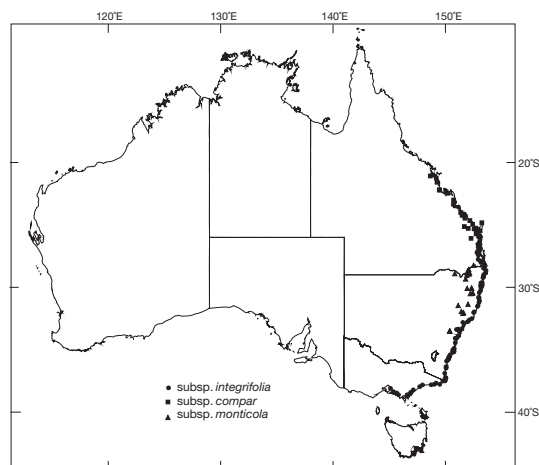
Related species: *Banksia aquilonia*, which occurs in north Queensland, differs in having scattered, narrowly obovate to lanceolate acute leaves, 5–20 × 6–12 cm. *B. dentata*, has larger, alternate, dentate leaves and inhabits swamps across tropical Australia. *B. saxicola*, which occurs in the Grampians and on Wilsons Promontory, Victoria, has thinner bark and leaves, yellow flowers that are often tinged grey, and larger, thicker follicles.

Publication: Subsp. *integrifolia*: *Suppl. Pl.* 127 (1781). Type: Botany Bay, New South Wales, 1770, J. Banks. Subsp. *compar* (R.Br.) K.R. Thiele: *Aust. Syst. Bot.* 7, 406 (1994). Type: Keppel Bay, near Gladstone, Queensland, R. Brown. Subsp. *monticola* K.R. Thiele: *Aust. Syst. Bot.* 7, 406 (1994). Type: Mount Wilson, Blue Mountains, New South Wales, 3 Nov. 1979, A.S. George 15794.

Names: Botanical—Latin *integer* (whole or entire), plus *folium* (leaf), alluding to the adult leaves which do not have serrated or lobed edges, Latin *compar* (similar) refers to its affinity with subsp. *interifolia*; Latin *montanus* (growing on mountains), Latin *cola* (dweller) refers to its habitat. Common—refers to its most common habitat.

Bark: A slightly rough light-grey bark which is persistent on the trunk and main limbs. Slightly granular in appearance.

Leaves: Cotyledons—sessile, obovate, emarginate, up to 1 × 0.7 cm, heart-shaped venation, opposite basal tips conjoined;



hypocotyl terete, red, hairy. Seedling—alternate, shortly petiolate, cuneate to oblanceolate, 2–6 × 0.5–2 cm, serrate, upper surface green, undersurface densely white tomentose; venation reticulate and visible on both surfaces. Coppice leaves are similar to the juvenile leaves. Adult—alternate with new adult leaves in whorls of 4–6, older leaves in less perfect whorls because of intranodal extensions, shortly petiolate, cuneate to oblanceolate, attenuate, 4–20 × 1–2.6 cm, leaf edges entire and often recurved; dark green above and white underneath due to dense covering of minute hairs. The venation is distinctly reticulate and major veins are often yellow coloured. Old senescent leaves are yellowish and persistent for some time. Subsp. *compar* has bigger (up to 20 cm long), glossier and more undulate leaves than var. *integrifolia*, while subsp. *monticola* has acute, narrowly elliptic leaves, commonly 10–13 × 1.7–1.9 cm, that are shining above.

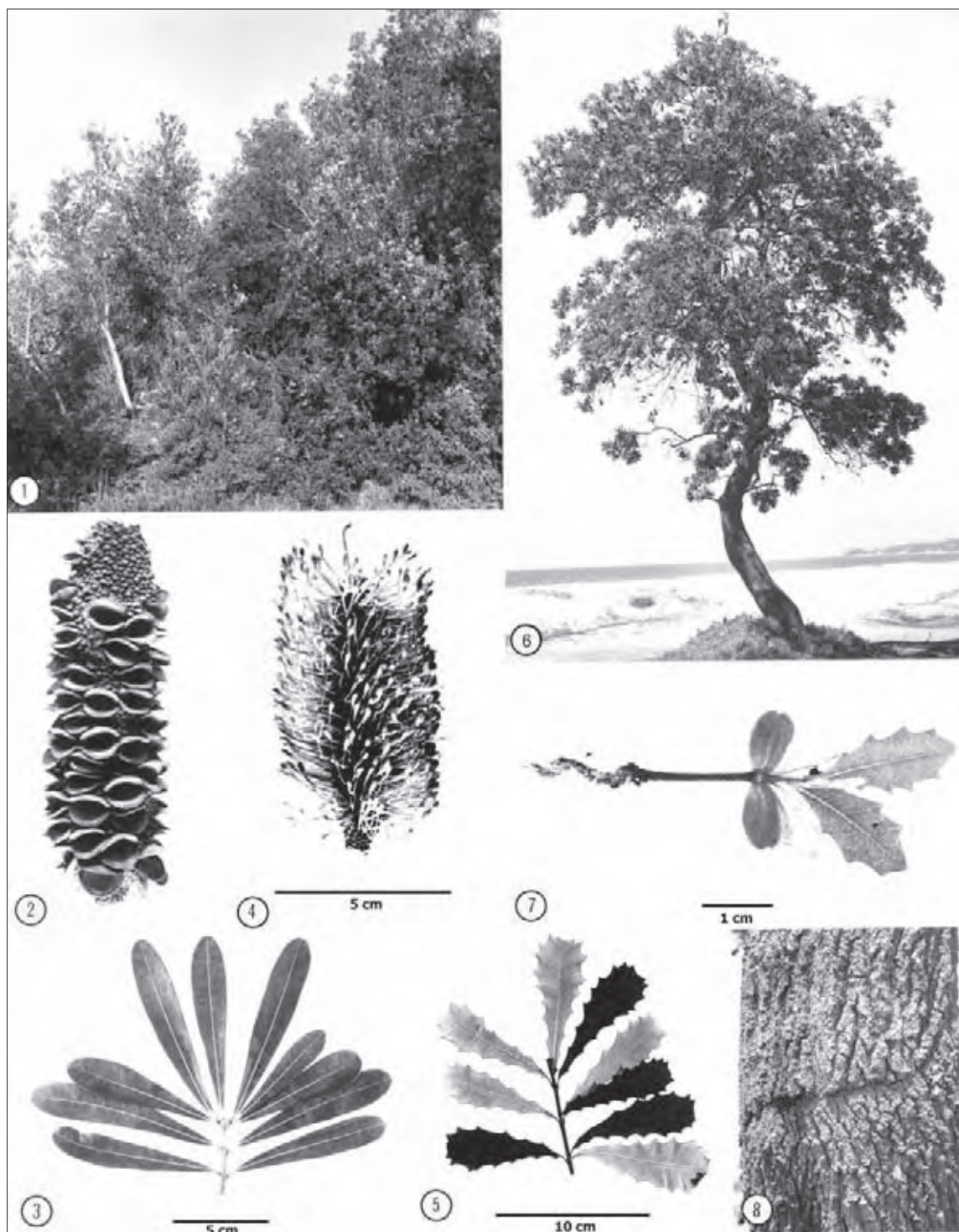
Inflorescences: Terminal spikes about 5 × 10 cm. Styles finally straight after release from the perianth parts, stigma small and thin, both bracts and bracteoles densely woolly. Flowers Jan.–Jul. Flowers produce a dark amber-coloured honey of medium value.

Fruits: Spikes oblong or cylindrical, 7–15 × 7–8 cm, free of withered perianths and styles, often only 2–10 follicles develop and produce seed. Valves rather thin. Seed black, winged, ovate, up to 1.7 × 0.7 cm (including wing). Usually 2 seeds per follicle, often released spontaneously, usually within a year after maturation.

Wood: Heartwood pinkish to deep red-brown, spongy, porous, with conspicuous rays; interlocked grain sometimes wavy, density 530 kg m⁻³. Timber warps badly on drying but is useful for ornamental turnery. Occasionally used for cabinetwork and in panellings where a red-hued, ray-blazoned timber is required.

Climate: Altitudinal range: near sea level to 1500 m; hottest/coldest month: 25–31°C/0–15°C; Frost incidence: low to moderate (upland sites up to 100 per year); Rainfall: 650–2000 mm per year, summer max. in the north, uniform in the south.

Distinctive features: A medium-sized coastal tree with leaves in whorls. Adult leaves are oblanceolate and entire with dense white hair underneath.



Banksia integrifolia 1. Stand, Coffs Harbour, N.S.W. 2. Fruit after dehiscence 3. Adult leaves 4. Inflorescence 5. Intermediate leaves 6. Tree, Valla Beach, N.S.W. 7. Seedling showing emarginate cotyledons 8. Bark

Saw Banksia

Saw-tooth Banksia, Red Honeysuckle

Banksia serrata L. f.

Saw banksia is usually a medium-sized, gnarled misshapen tree 10–15 m tall with a stout, knobbly trunk 0.75 m in diameter. The trunk is often blackened from past bushfires and exudes a reddish sap when wounded. The foliage is rather stiff and sparse on the tree, giving the canopy a rather thin appearance.

This species grows along the east coast of Australia from Wilsons Promontory, Victoria, to Cooloola near Tin Can Bay, Queensland. There is one small isolated occurrence at Sisters Creek in Rocky Cape National Park near Burnie, Tasmania, and offshore occurrences include Gabo Island. It is often found very close to the coast and usually does not extend far inland. Typical sites where the species grows are Burrawarra Point, Nadgee Flora Reserve and around Sydney, New South Wales.

Saw banksia favours well-drained sandy soils and is found commonly behind the main dune of the coastline on stabilised sand. It can also be found on shallow sandy soils derived from sandstone in the Sydney region.

Saw banksia typically occurs in open forests or woodlands as an understorey to various eucalypts. On deep sandy soils, close to the coast, common associates in the southern part of its range are bangalay (*Eucalyptus botryoides*), brown stringybark (*E. baxteri*), white stringybark (*E. globoidea*), occasionally silvertop ash (*E. sieberi*) and yertchuk (*E. consideniana*). In the middle part of its range it is commonly associated with red bloodwood (*E. gummifera*), blackbutt (*E. pilularis*) and especially smooth-barked apple (*Angophora costata*) in the Myall Lake region. Farther north in Queensland it is commonly associated with white mahogany (*E. umbra*).

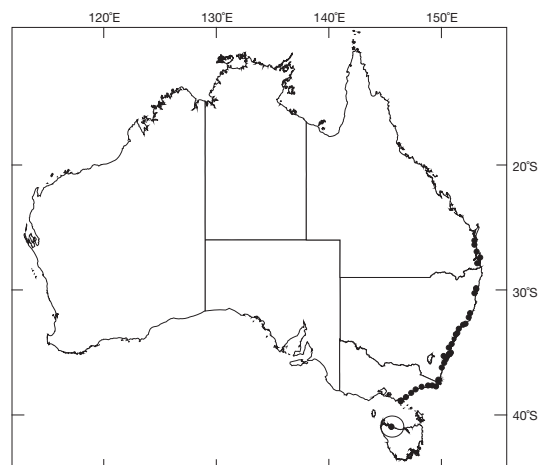
Related species: Saw banksia is closely related to wallum banksia (*B. aemula*) from which it differs in its generally taller habit and in the shape and size of the stigma—the stigma of *B. serrata* is cylindrical and about 0.2 cm long while that of *B. aemula* is ovoid and only about 0.1 cm long. Wallum banksia occurs from near Sydney to north of Bundaberg, Queensland.

Publication: *Suppl. Pl.* 126 (1782). Type: Botany Bay, New South Wales, Apr.–May, 1770, J. Banks.

Names: Botanical and common—Latin *serratus* (saw edged, serrate), alluding to the highly serrated, forward pointing, leaf edges that are reminiscent of saw teeth.

Bark: A spongy grey bark with occasional longitudinal furrows on older trees. New bark exposed after fires is bright orange in colour.

Leaves: Cotyledons—opposite, conjoined, obovate, up to 1.2 × 1.5 cm with projecting tips at base; venation heart-shaped; hypocotyl terete, red, finely hairy. Seedling—first 2 pairs more or less opposite then alternate; petioles about 1–2 cm long with slightly swollen bases; obovate, up to 16 × 2.5 cm, serrate with triangular indentations up to 0.5 cm deep, leaves ending in 3 acute teeth; dark green above and light green beneath, stem and new leaves covered in long (up to 0.5 cm) white silky hairs. Adult—alternate, petiolate, oblong-lanceolate, often truncate,



8–20 × 2–4 cm, margins deeply serrate, dark glossy green and glabrous above, light green underneath sometimes with rusty coloured hairs on veins on the undersurface but usually hairless; conspicuous parallel transverse veins. New adult foliage copper-coloured and soft and hairy on both leaf surfaces. Older foliage tough and leathery.

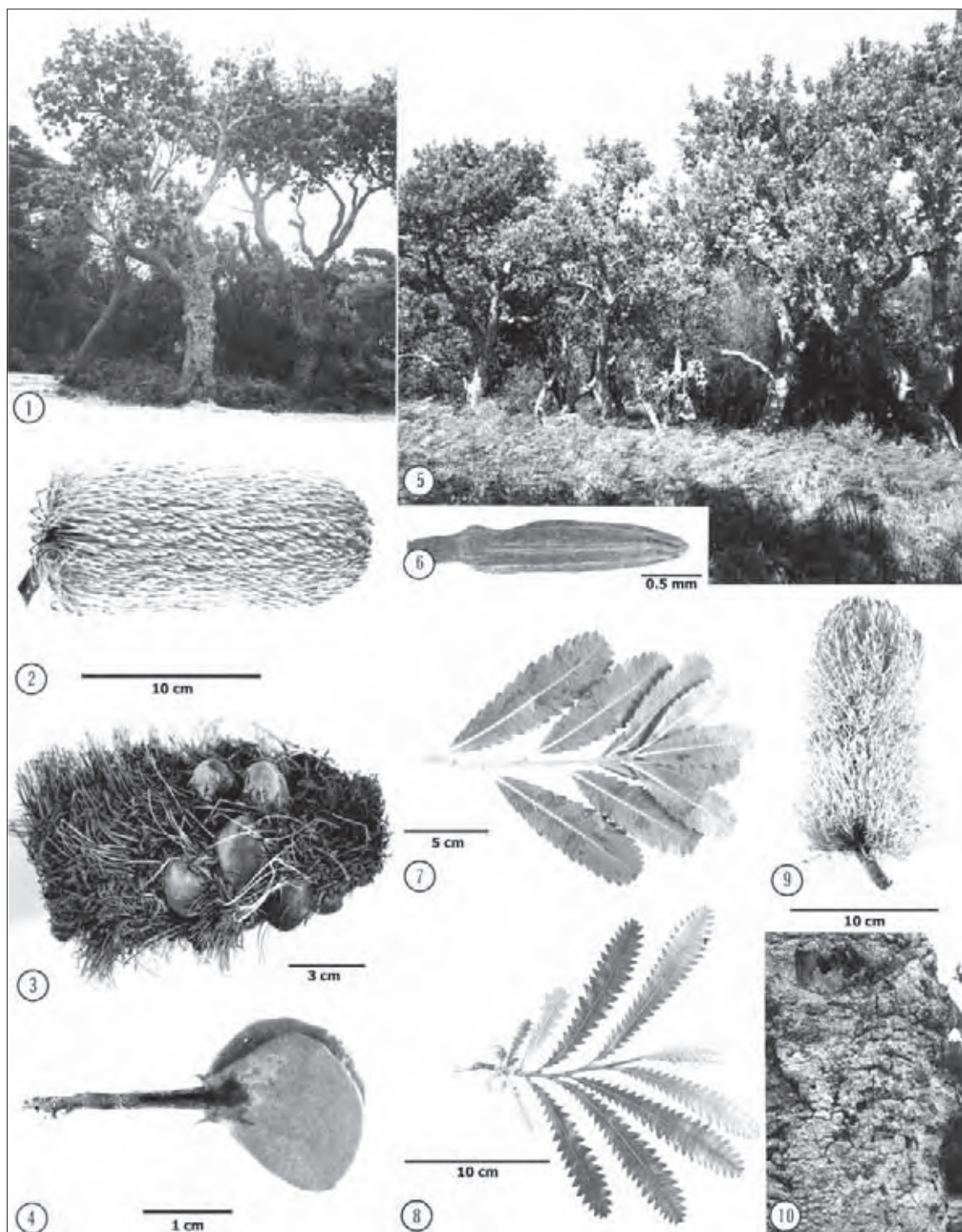
Inflorescences: Terminal spikes, oblong cylindrical, 7–15 × 8–10 cm. In bud, the flowers are characteristically silver grey, soft and silky to touch due to hairs on the perianth parts. Styles when finally released are straight and golden in colour; they are released from the bottom of the spike upwards. Stigma cylindrical and about 0.2 cm long. The styles are captured for a long period and it is the silver-grey bud colour which predominates for most of the flowering period. Flowers Jan.–Jun.

Fruits: Spikes cylindrical, upright, about 13–15 × 8–10 cm, with 5–12 horizontally disposed follicles per spike. The follicles are thick and rounded, up to 3 cm wide, are initially clad with a dense velvety grey tomentum and the colour gradually changes from coppery red to a slaty grey. The follicles tightly enclose the seeds for several years until fires activate release. Seed black, winged, up to about 1 × 1 cm. The fruiting structures often appear very shaggy due to the presence of persistent dead styles.

Wood: The wood is much deeper red than that of coast banksia (*B. integrifolia*), usually with a purplish tinge, with distinctive wide rays; grain wavy to interlocked, fine but uneven texture; density 720 kg m⁻³. The timber has limited use but has been used for keels for small boats. The grain is very attractive for ornamental purposes.

Climate: Altitudinal range: near sea level to about 200 m; hottest/coldest month: 21–28°C/3–8°C; Frost incidence: low; Rainfall: 800–1500 mm per year, summer max. in the north to more uniform in the south.

Distinctive features: A serrated-leaf *Banksia* with large inflorescences that are silver-grey until the styles are released. New foliage is hairy, copper-coloured, fruits are large.



Banksia serrata 1. Trees, near Batemans Bay, N.S.W. 2. Floral buds 3. Fruits 4. Cotyledon 5. Stand, near Batemans Bay, N.S.W. 6. Stigma 7. Adult leaves 8. Seedling 9. Flowers 10. Bark

Northern Silky Oak Bull Oak, Oak, Silky Oak

Cardwellia sublimis F. Muell.

Northern silky oak is a medium-sized to tall tree attaining 40 m in height and 2.2 m in diameter. The trunk (usually without buttresses) is not always straight, but seldom too crooked to produce millable logs.

This species has a limited distribution in northern Queensland between Mt Spec near Townsville and Bloomfield. The distribution seldom extends more than about 60 km from the coast.

The species occurs on many soil types varying from shallow skeletal soils to deep well-drained soils on basalt, granite and metamorphic rocks.

Northern silky oak grows in most northern Queensland rainforest types and is associated with a large number of rainforest tree species.

Related species: *Cardwellia* is a monotypic endemic genus reviewed by Hyland (1995).

Publication: *Fragm.* 5, 24 (1865). Type: Rockingham Bay, northern Queensland, J. Dallachy.

Names: Botanical—*Cardwellia*, in honour of the Rt Hon. E. Cardwell, M.P., later Viscount Cardwell (1813–1886), Secretary for the Colonies (1864–66); *sublimis*, from the Latin *sublimis* (somewhat lofty), alluding to the large stature of the tree from which the type was chosen. Common—alludes to its Australian occurrence and the wood texture which is similar to that in true oaks (*Quercus* spp.).

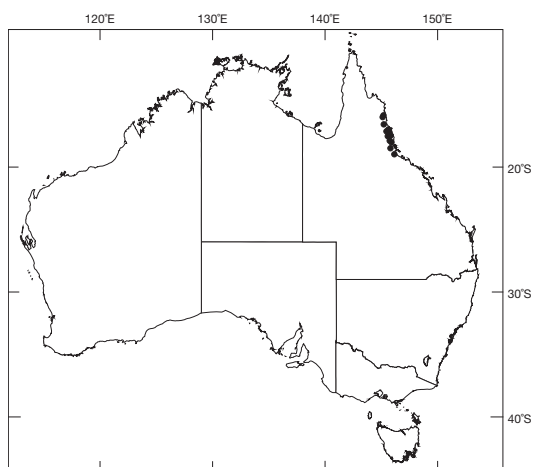
Bark: Slightly flaky to nondescript. The outer blaze is commonly biscuit-brown in colour.

Leaves: Cotyledons—almost sessile, transversely obovate or obtriangulate, about $2\text{--}2.5 \times 6\text{--}8$ cm. Seedling—alternate, petioles about 1 cm long, simple, elliptical-oblongate, acuminate, attenuate, $4\text{--}7 \times 1\text{--}1.7$ cm, iridescent brownish or purplish on the underside when fresh; venation reticulate, prominent on both surfaces, raised on undersurface. Adult—spirally arranged, pinnate, leaflets 5–12 or more, opposite, subopposite, terminal leaflet absent. Leaflets oblong, ovate, about $8\text{--}17 \times 3.5\text{--}6.5$ cm, petiolule about 1–2 cm long. Underside of leaflets iridescent brown when fresh. Lateral veins about 8–15 pairs forming indistinct loops inside the blade margin. The twigs have numerous small lenticels, usually visible to the naked eye; a distinctive oak grain is present in the wood of twigs.

Inflorescences: Terminal and in the upper axils, usually a panicle accumulation of spike-like racemes. Flowers arranged in pairs in each raceme. Flower buds spatulate in outline, 1–2 cm long, tepals 4, cream, shortly hairy inside and out. Stamens 4, sessile near the apex of each tepal. Ovary 1-celled, 4 glands at the base, ovules about 12–16. Style long, dilated at the apex. Flowers Oct.–Dec.

Fruits: Oval, woody follicles, each about $8\text{--}12 \times 5\text{--}8$ cm before opening. Seeds brown, flat, narrowly winged around the margin, about 7×3 cm. Embryo about 5.5×2.0 cm.

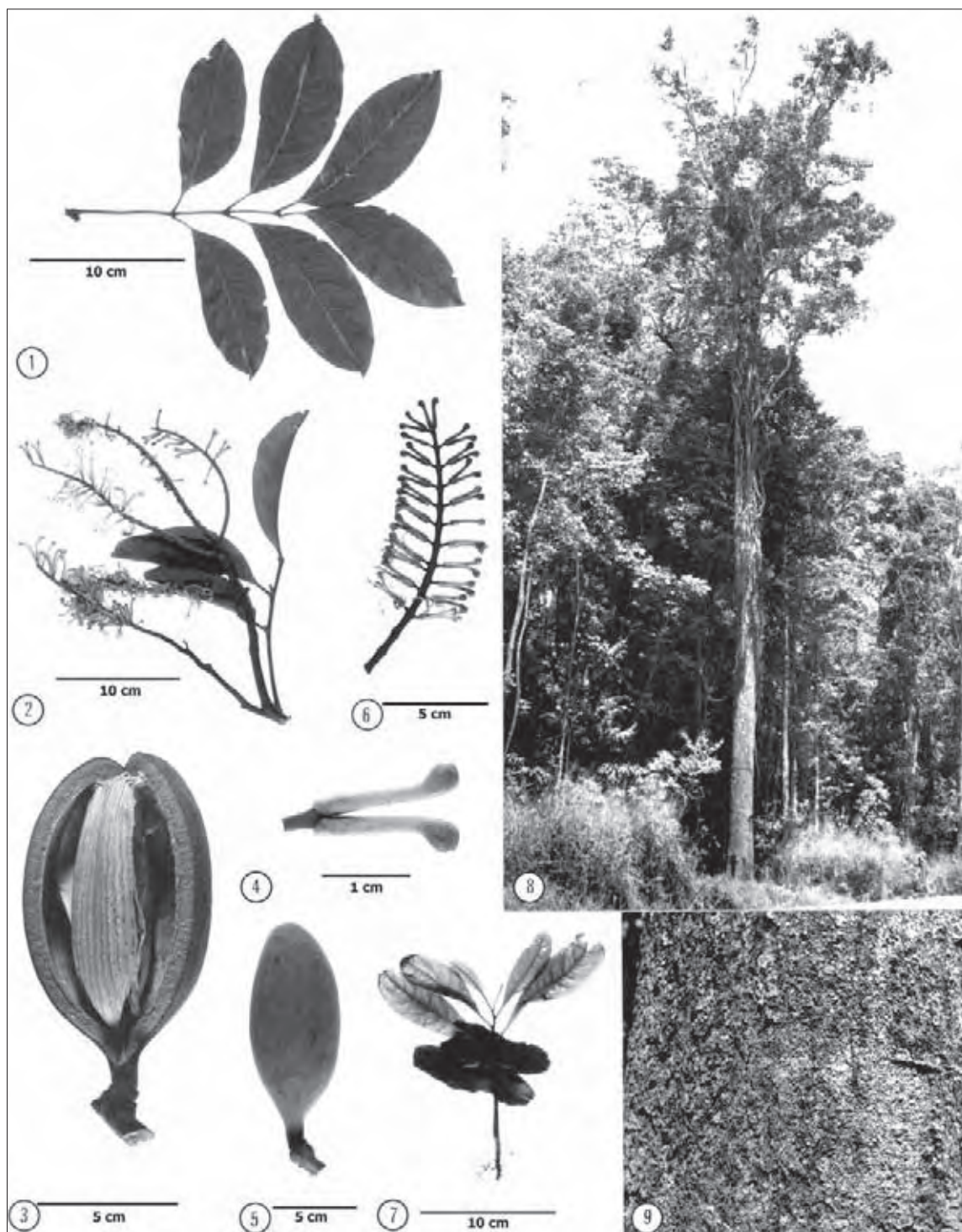
Wood: Sapwood susceptible to *Lyctus* attack; heartwood pale pinkish brown to brown marked by a decorative 'oak-like' grain, pores (wood-vessels) with occasional deposits of aluminium succinate, not durable in contact with the ground, above ground durability not known, density $430\text{--}915 \text{ kg m}^{-3}$.



Works and glues well. Suitable for peeling and high class cabinetwork as well as house cladding. In the past, northern silky oak was the mainstay of the northern Queensland timber industry and comprised about 10–15 per cent of the total mill intake.

Climate: Altitudinal range: near sea level to 1000 m; hottest/coldest month: $30\text{--}32^\circ\text{C}/10\text{--}19^\circ\text{C}$; Frost incidence: low (except upland sites); Rainfall: 1500–3700 mm per year, summer max.

Distinctive features: Biscuit-brown blaze, oak grain in the inner blaze, stem wood and twigs. Pinnate leaves; large woody fruits, seeds with marginal wings.



Cardwellia sublimis 1. Adult leaves 2. Inflorescences, both buds and flowers 3. Open fruit exposing seeds 4. Pair of buds 5. Closed fruit 6. Inflorescence 7. Seedling with pair of cotyledons 8. Tree, between Mt Garnet and Ravenshoe, Qld 9. Bark

Silver Oak Beefwood

Grevillea parallela Knight

Silver oak is often a slender, erect, small tree attaining a height of 8 m with a diameter of 0.4 m and an unbuttressed stem. Sometimes it occurs as a shrub to 3 m tall, and pendulous forms also occur.

This species has a wide distribution across northern Australia, being found in northern and central Queensland from Cape York Peninsula south to the Tambo region, and Northern Territory and the Kimberley region of Western Australia, where it is widespread north of the 20th parallel.

Soils and rock substrates are very variable. Soils are often sandy and range from gravelly sands derived from laterite, granite or sandstone to sandy fine-grained clays in seasonally wet depressions.

Silver oak is a component of the open forests and woodlands. Over its considerable range there are numerous associated species. Some common species include many species of bloodwood eucalypts (e.g. *E. polycarpa*, *E. nesophila*, *E. tessellaris*), other eucalypts such as Darwin stringybark (*E. tetradonta*), northern woollybutt (*E. miniata*) and white gum (*E. platyphylla*), melaleucas (e.g. *M. viridiflora*) and cocky apple (*Planchonia careya*).

Related species: There are 357 species of *Grevillea* in Australia, three species in New Guinea (one endemic), three endemic species in New Caledonia, and one endemic species in Sulawesi (Makinson 2000). The genus has been revised in recent times with numerous new species recognised and a number of publications produced, e.g. McGillivray and Makinson (1993) and Olde and Marriott (1994–5). The closest relative of silver oak is probably *G. coriacea*, which has simple leaves with usually only three longitudinal nerves and a longer style.

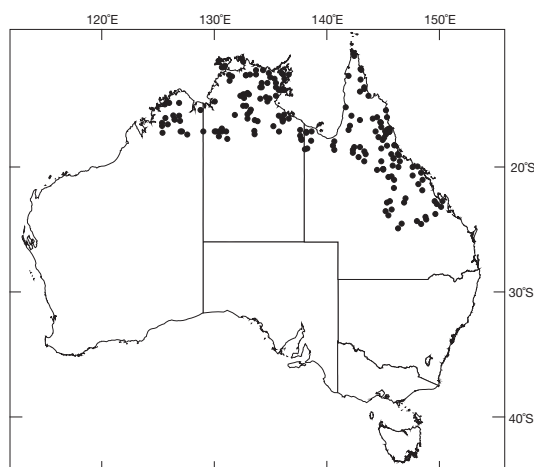
Publication: *Cult. Prot.* 121 (1809). Type: Endeavour River, Cape Fear, 1770, J. Banks and D. Solander.

Names: Botanical—*Grevillea*, honours C.F. Greville (1749–1809), one of the founders of the Horticultural Society of London and Vice-President of the Royal Society; *parallela*, from the Latin *parallelus* (parallel), alluding to the parallel veins in the leaf. Common—alludes to the silvery sheen on the underside of the leaves and the similarity of the grain to that of the true oaks (*Quercus* spp.).

Bark: Dark, rough, furrowed, flaky to tessellated.

Leaves: Cotyledons—sessile, ovate truncate, cordate. Seedling—alternate, sessile, entire, linear to linear-lanceolate, acute, 1–19 × 0.3–0.5 cm, margins recurved, discolorous, few simple hairs scattered over leaf blade, mostly on upper surface; venation visible, midrib distinct. Adult—alternate, petioles about 0.3–1 cm long; linear, linear-lanceolate or deeply incised and pinnatifid with up to 6 lobes; lamina 14–37 × 0.2–0.7 cm, pale or silvery on the underside; veins parallel, the midrib and 2–6 other veins visible.

Inflorescences: Terminal group of racemes. Flowers cream, 4-merous, tepals about 1 cm long, curved in the bud and twisted at anthesis. Stamens 4, anthers sessile near the apex of the tepals. Ovary shortly stalked, with a horseshoe-shaped gland at the base. Ovary 1-celled containing 2 ovules. Style about



1.5–2 cm long, stigma terminal, slightly swollen. Flowers Jul.–Oct.

Fruits: Oblong follicles about 1.5–2 cm diameter. Seeds 1–2, bordered all around by a membranous wing. Seed plus wing about 1.5 cm diameter.

Wood: Sapwood susceptible to *Lyctus* attack; heartwood brown to pink-brown marked by a decorative oak grain, lustrous, density about 880 kg m⁻³. Durable when exposed to the weather and when in contact with the ground.

Climate: Altitudinal range: near sea level to 900 m; hottest/coldest month: 30–40°C/11–22°C; Frost incidence: low (except upland sites in Qld.); Rainfall: 700–1700 mm per year, summer max.

Distinctive features: Small tree in open forests, bark rough and dark, leaves or leaf lobes long and narrow, pale or silvery on the underside, veins fine, parallel to the midrib, flowers cream, 4-merous, anthers sessile on the tepals, fruit a follicle, seeds winged all around, wood with an oak grain. Conspicuous and showy when in flower.



Grevillea parallelia 1. Adult leaves 2. Adult leaves and inflorescences 3. Fruits 4. Seedling showing cotyledons and seedling leaves 5. Tree, Springmount Holding near Atherton, Qld 6. Inflorescence 7. Four fruits 8. Four seeds 9. Bark

Silky Oak

Grevillea robusta A. Cunn. ex R. Br.

Silky oak is a medium-sized tree 20–30 m in height and 0.8 m in diameter but occasionally reaching 37 m tall and 1 m diameter. When open-grown the crown is pyramidal to conical in shape and has an open canopy. The fern-like foliage of this species is very distinctive in the forest. The species is semi-deciduous being almost leafless shortly before flowering period in late spring.

Silky oak occurs in the dry upper reaches of coastal rivers in northern New South Wales and southern Queensland. It occurs from the Orara River area, just west of Coffs Harbour, New South Wales, to Mt Cordeaux (Cunninghams Gap) and North Pine River (Petrie area), Queensland, and inland to the Bunya Mountains, Queensland, and Guy Fawkes Gorge, near Ebor, New South Wales. Silky oak is now relatively rare in its natural state.

Silky oak is often found growing along or in the vicinity of streams. Soils are alluvia, of relatively high fertility and with good moisture availability. Silky oak also occurs in *Araucaria*-dominated vine forests and thickets, well away from riparian habitats. These occurrences are on steep valley slopes, rolling terrain or dry exposed hillsides on fertile soils derived from basalt. There are also some occurrences on shallower less fertile soils derived from sedimentary rocks.

Associates in the riverine occurrences include the black bean (*Castanospermum australe*) closed rainforest alliance, while on the drier creeks there may be open forests dominated by river sheoak (*Casuarina cunninghamiana*). Associates in the closed *Araucaria*-dominated vine forests and thickets include bunya pine (*Araucaria bidwillii*), hoop pine (*Araucaria cunninghamii*) and brush kurrajong (*Brachychiton discolor*). The species seeds well and regenerates strongly after any site disturbance in rainforests.

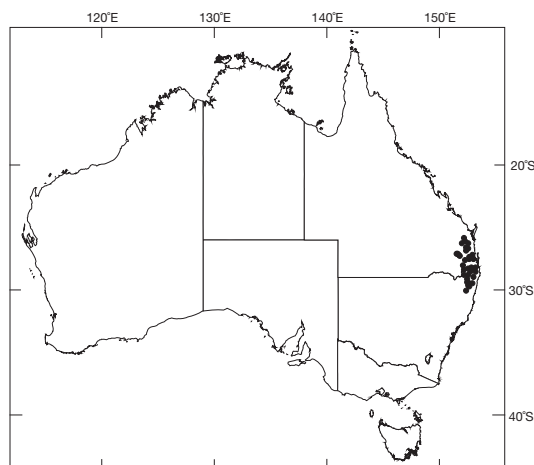
Related species: There are 357 species of *Grevillea* in Australia, 3 in New Guinea (one endemic), 3 endemic species in New Caledonia, and one endemic to Sulawesi (Makinson 2000). *Grevilleas* range in size from small prostrate shrubs to tall trees such as silky oak, which is the largest species in the genus. Silky oak has no close relatives in Australia; *G. exul* Lindl., from New Caledonia, is probably its only relative.

Publication: *Suppl. Prodr. Fl. Nov. Holl.* 24 (1830). Type: Beside the Brisbane River, Queensland, 1827, A. Cunninghamham.

Names: Botanical—*Grevillea*, honours C.F. Greville (1749–1809) who was an English patron of botany; *robusta*, from the Latin *robustus* (hard, strong, robust), in reference to its size in a genus of many species of shrubs. Common—alludes to the fact that the wood resembles oak (*Quercus* spp.) in appearance, and silky because of the wood texture when freshly split.

Bark: Dark grey and furrowed into a lace-like pattern. A cut blaze reveals a reddish-brown bark with a pink inner bark. The outer bark has conspicuous vertical lenticels about 0.5–1 cm in length.

Leaves: Cotyledons—sessile, base of cotyledon recurved down the hypocotyl and consists of sharp points on either side of the



hypocotyl, obovate, up to 1.3 × 0.9 cm, margins hairy; hypocotyl green with long slender white hairs. Seedling—alternate; petioles to 0.5–1.5 cm long; first pairs pinnately divided into numerous segments, 1–4 cm long, segments again divided, rachis winged, whole seedling covered in silky hairs, green, discolorous; only midrib visible and raised on undersurface. Adult—alternate, petiolate, graceful and fern-like, compound, 15–25 × 8–12 cm, pinnately divided with 11–23 primary segments, early segment with short stalk about 0.6 cm long, each segment may again be divided or lobed; glabrous above, white-hairy beneath. Young branches are covered with rusty coloured hairs and are velvety in appearance.

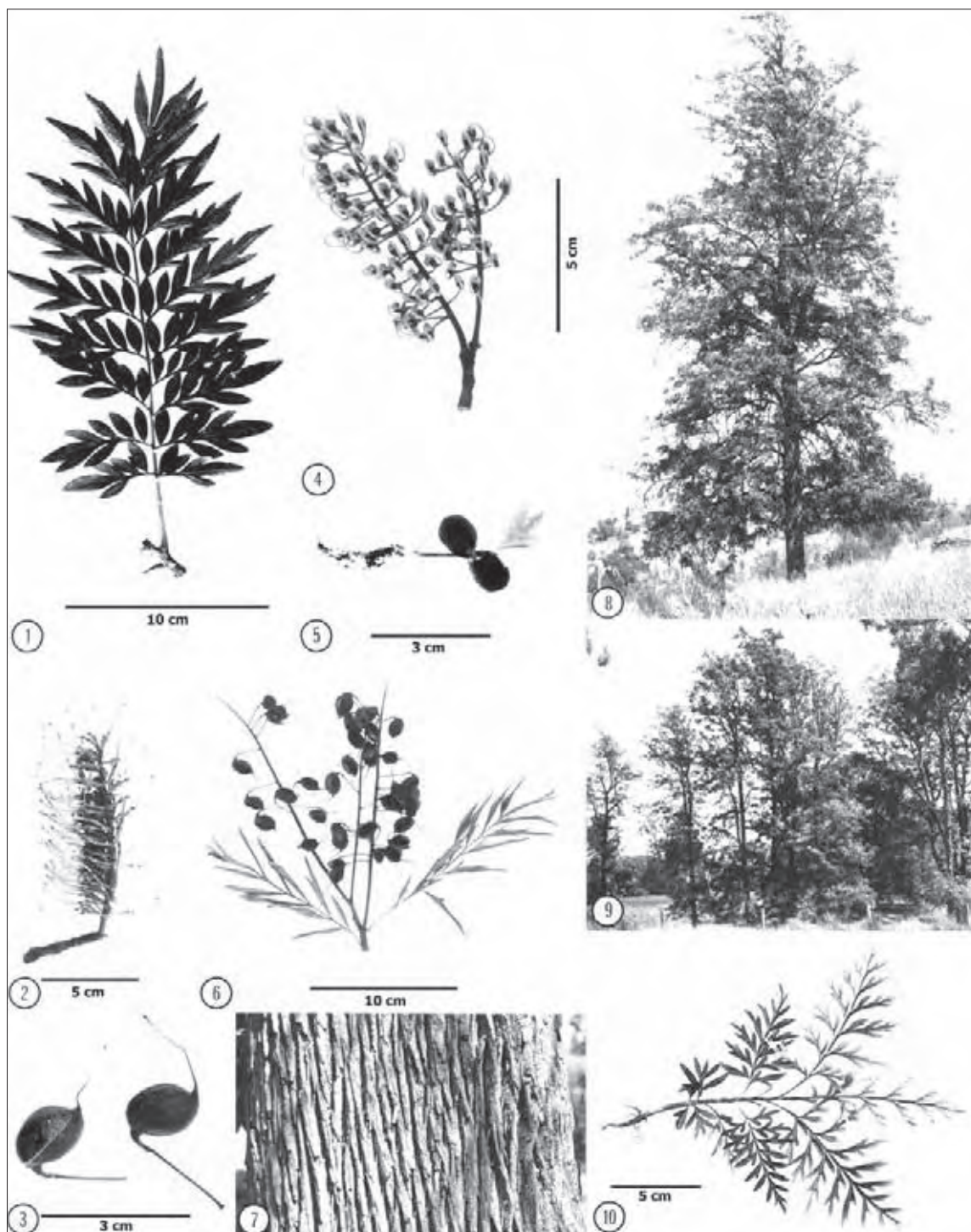
Inflorescences: Racemes 7–13 cm long, produced on older wood. Flowers in pairs. Individual flowers bright orange-yellow in colour, about 2 cm long and on pedicels 1.5–2 cm long. Perianth, 4 narrow tepals, 0.6–1.0 cm long with the concave summit of each tepal holding a small anther 0.1 cm long. Ovary surmounts a gynophore 0.2–0.3 cm long. Style usually protrudes from a slit on the lower side of the perianth tube before the summit (containing the stigma) is set free, and once free the style finally straightens. Flowers Oct.–Nov.

Fruits: Boat-shaped 2-seeded follicles, up to 2 cm long and tipped with a slender persistent style. The seeds are brown, flat, ovate-oblong, about 1 × 0.5 cm, with a shiny centre surrounded by a light brown papery wing. Mature Dec.–Jan.

Wood: Sapwood pale, subject to *Lyctus* borer: heartwood yellow-brown, pinkish brown to red-brown on exposure, pores (vessels) with red deposits with a silky lustre and an 'oak-like' figure, soft, tough, density 550–675 kg m⁻³. The timber seasons without difficulty and is one of the finest cabinet timbers; it works easily and is used for furniture, turnery, indoor fittings and plywood, but supply is limited.

Climate: Altitudinal range: near sea level to 1120 m; hottest/coldest month: 28–30°C/5–6°C; Frost incidence: low to moderate (occasional frosts each year in most localities); Rainfall: 720–1710 mm per year, summer max.

Distinctive features: Fern-like leaves (whitish beneath), small boat-shaped follicles and bright orange-yellow flowers. Silky oak is planted as a street tree in southern and central Australia, and in such countries as India and parts of Africa.



Grevillea robusta 1. Adult leaves 2. Inflorescence after flowering 3. Fruits 4. Inflorescence at flowering 5. Pair of cotyledons 6. Fruiting branch 7. Bark 8. Tree, between Bunya Mtn and Dalby, Qld 9. Stand, between Bunya Mtn and Dalby, Qld 10. Seedling

Small-stilted Mangrove

Rhizophora stylosa Griff.

Small-stilted mangrove grows as a single or multi-stemmed tree up to 30 m tall and 0.6 m diameter but is usually 8–10 m tall and 0.25–0.3 m in diameter, with looping pneumatophores extending for several metres over the soil surface. Aerial roots descend from the stem and branches. The crown is dark glossy-green and quite compact.

This species occurs on coastal and estuarine sites around the northern half of Australia from just north of Coffs Harbour, New South Wales, to Exmouth, Western Australia. The species is also common in sheltered bays and fringing islands. Outside Australia it is less common, but occurs from Taiwan and Malaysia to the Solomon Islands and Fiji.

The species forms closed forests commonly on beachfronts or lower tidal reaches, as pure stands or with a seaward fringe of *Sonneratia* spp., *Avicennia marina* or *Camptostemon* spp. The species may extend upstream and attains greatest development in portions of tidal waterways that remain brackish for most of the year.

Related species: Three other species of *Rhizophora* are found on Australian coasts; *R. apiculata* and *R. lamarckii* have elliptical leaves, without spots; *R. mucronata* has styles less than 0.25 cm long. Other Australian mangroves in the family Rhizophoraceae include species of *Bruguiera* and *Ceriops*.

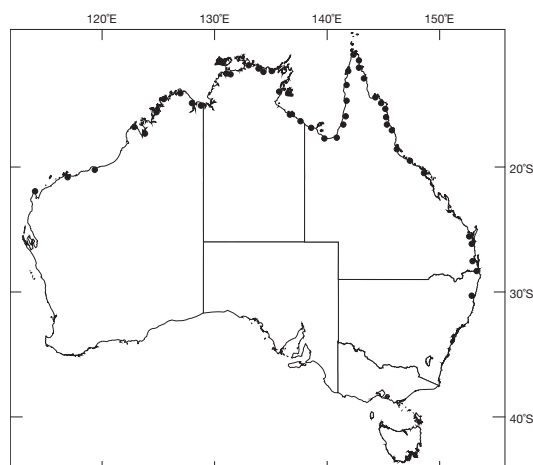
Publication: *Not. Pl. Asiat.* (Bishops College Press), 4, 655 (1854), and in *Ic. Pl. Asiat.* 4, pl. 640 (1854). Type: Pulo Bissar, Malacca.

Names: Botanical—*Rhizophora*, from the Greek *rhiza* (root), plus *phoreo* (to bear), alluding to the fact that the plant sends down aerial roots which act as stays; *stylosa*, from the Latin *stylus* (style), plus *-osus* (abounding in), alluding to the long styles. Common—refers to the looping pneumatophores that appear to act like stilts.

Bark: Single-stemmed trees with smooth, red-brown bark are common in exposed situations, but multi-stemmed trees with grey-fissured bark on the stems and pale brown prop-roots are common in sheltered sites; at times the whole bark area is blackish-grey and deeply fissured.

Leaves: Cotyledons—fused to form a tubular structure which protrudes from the fruit at maturity, but is left intact when the seedling falls. Adult—opposite, decussate; petioles to 1–4 cm long; obovate, 6–14 × 4–8 cm, entire with a revolute margin and mucronate tip 0.2–0.6 cm long; upper surface of the leaf smooth, shiny, bright yellow-green; lower surface paler, marked by red-brown spots. Stipules interpetiolar, reddish, lanceolate, 3–6 cm long, falling early, forming a protective cap to the growing shoot.

Inflorescences: 2, 4 or 6-branched cymes, flowers on short pedicels subtended by cup-shaped bracteoles. Calyx deeply 4-lobed, reflexed in fruit. Petals 4, lanceolate, about 1.2 × 0.4 cm with woolly margins. Stamens normally 8, opening in a large valve, with very short filaments inserted on the margin of an annular disc. Ovary semi-inferior, 2-celled with 2 ovules in each. Style narrow, 0.3–0.5 cm long.



Fruits: Ovoid, carrying the 4 reflexed calyx lobes at the base, 3–5 × 2–3 cm. The single seed germinates while the fruit is attached to the tree and the hypocotyl grows out from the apex; hypocotyl at maturity is 26–65 × 1.2–2 cm, cylindrical, pointed, with a smooth green surface bearing irregular small brown lenticels. When the seedling is shed by separation from the cotyledonary tube the first leaves are tightly rolled into a narrow awl-shaped plumule.

Wood: Not much is known about the wood. It has an air-dry density similar but it probably has a density similar to that of red mangrove (*R. mucronata*), which is 905–1010 kg m⁻³. The timber has been used for firewood, charcoal, tanning and in South-East Asia for rayon pulp. Like the wood of *R. mucronata*, which has very narrow sapwood that is resistant to Lyctus attack, it has a purplish-red, dark red-brown to yellowish red heartwood. Heartwood of *R. mucronata* is durable and termite resistant, texture is fine to very fine, with straight grain; useful for heavy structures in the marine environment, bridge decking and provides a good charcoal, the bark is a source of brown and black dye.

Climate: Altitudinal range: sea level to 5 m; hottest/coldest month: 29–36°C/over 10°C; Frost incidence: nil/low; Rainfall: 650–3500 mm per year, summer max. Note: climate for this species is strongly affected by the modifying effects of the sea and the strong control of soil water conditions and aeration by the tides.

Distinctive features: Looping pneumatophores and stilt roots from stems and branches, elongated cylindrical hypocotyl on the fruit while the fruit is still attached to the tree, red-brown spots on the leaves, and styles 0.3–0.5 cm.



Rhizophora stylosa 1. Bark 2. Aerial roots 3. Flowers 4. Seedlings showing roots and pointed cotyledons 5. Tree, near Tweed Heads, N.S.W. 6. Fruit with emergent radicle 7. Adult leaves and convolute, interpetiolar stipules

Cheesewood

Leichhardt Pine (N.T.), Yellow Cheesewood

Nauclea orientalis (L.) L.

Cheesewood varies from a medium-sized to tall, well-formed tree, attaining a height of 30 m and a diameter of 1 m. The stem is not buttressed. Trees are usually deciduous each year, being leafless during August or September.

Cheesewood has a wide distribution in tropical Australia extending along the Queensland coast from about Gladstone to Iron Range and along the edge of the Gulf of Carpentaria. It also occurs in the Northern Territory and the Kimberley region of Western Australia. Outside Australia it occurs in New Guinea, Malaysia, South-East Asia (Burma, Thailand) and Sri Lanka.

The species occurs in a wide range of soil types but prefers alluvial soils along stream banks.

Cheesewood occurs in a variety of vegetation types from sparse rheophyte shrublands to tall well-developed gallery rainforest where it reaches its best development. Common associates include river red gum (*Eucalyptus camaldulensis*) and silver-leaved melaleuca (*Melaleuca argentea*) in the drier areas and black bean (*Castanospermum australe*), blush walnut (*Beilschmiedia obtusifolia*) and *Syzygium tierneyanum* in the wetter areas. In swampy areas it is often with *Melaleuca dealbata* and *M. leucadendra*.

Related species: No other species of *Nauclea* has been recorded in Australia. However, on Cape York Peninsula *N. orientalis* can be confused with *Anthocephalus chinensis*.

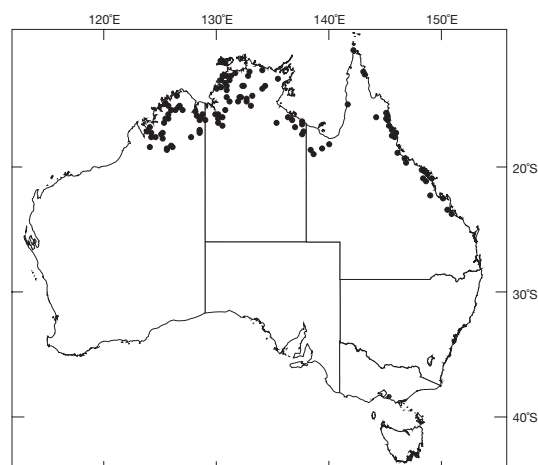
Publication: *Linnaeus Sp. Pl.*, edn 2, 1 (1762). Type: Plate 338 Hermann's herbarium, Ceylon?

Names: Botanical—*Nauclea* from the Latin *naucula* (a little ship); *orientalis* from the Latin *orientalis* (orient), pertaining to the east. Some authors suggest that the fruits of *Nauclea* resemble boats but this is an unlikely explanation. Linnaeus included two discordant elements in his concept of *N. orientalis* and it is conceivable that the fruits of the other element were boat-shaped. Common—cheesewood, because of the soft easily cut wood.

Bark: Somewhat flaky, outer blaze cream, yellowish, orange or pink, often with reddish layers visible as well.

Leaves: Cotyledons—small, elliptical. Seedling—opposite; petioles 2–3 cm long; entire, obovate-elliptic, obtuse, 7–27 × 4–14 cm, glabrous, shiny green above, discolourous; venation prominent, reticulate, raised on the undersurface, margin undulate. Seedlings are conspicuous by their large seedling leaves and the large interpetiolar stipules which are sessile, ovate, 0.8–2 × 0.8–1.5 cm. Adult—opposite; petioles 2–3.5 cm long; generally rather large, cordate, 10–27 × 6–17 cm, large obovate stipules about 1–3 cm long; lateral veins 7–12 pairs. If stipules on fresh twigs are carefully removed, a number of red glands resembling eggs of insects are usually visible on the inner surface near the base.

Inflorescences: Spherical heads about 3–5 cm diameter. Flowers yellowish or orange, calyx difficult to distinguish, corolla tube about 0.7–1 cm long, lobes (5–6) about 0.2–0.3 cm long. Stamens 5–6, anthers almost sessile at the mouth of the corolla tube, anthers about 1.5 mm long. Style and stigma



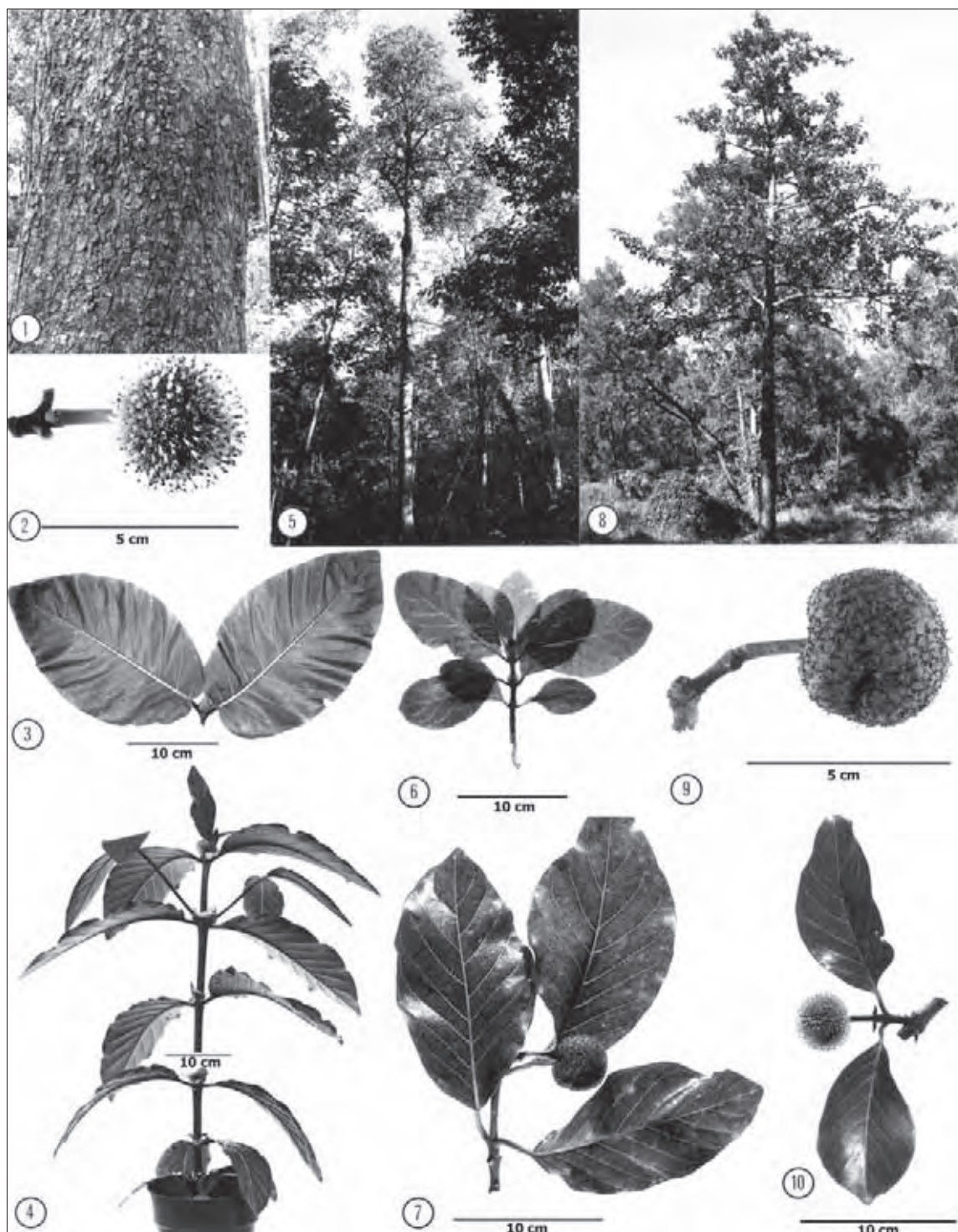
white, 1.5–1.7 cm long, expanded into a conical or bullet-shaped stigma at the apex. Flowers Sept.–Jan.

Fruits: A fleshy irregularly shaped globular mass containing numerous seeds. Each 'fruit' is actually an aggregation of many fruits, each produced from a single flower in the inflorescence. Aggregate fruit up to 5 cm or more in diameter. Seeds about 1.5 × 1.0 mm.

Wood: Sapwood susceptible to *Lyctus* attack; heartwood yellowish or orange (saffron-yellow), moderately fine-textured, grain slightly interlocked, with a greasy feel, soft and easily carved but not durable when exposed to the weather, density 440–645 kg m⁻³. The timber can be used for framing and internal flooring and other such uses, as long as it is not exposed to the weather. It can also be used for novelties where a timber with a distinctive colour is desirable, and it is suitable for veneer.

Climate: Altitudinal range: near sea level to 500 m; hottest/coldest month: 30–40°C/10–20°C; Frost incidence: low; Rainfall: 800–3800 mm per year (its habitat is typified by access to moisture during dry periods), summer max.

Distinctive features: Large leaves and large obovate stipules with red glands at the base, spherical heads of flowers and large malformed fruits.



Nauclea orientalis 1. Bark 2. Inflorescence 3. Adult leaves 4. Advanced seedling showing stipules 5. Tree, near Barron River, Mareeba, Qld 6. Young seedling 7. Adult leaves and fruit 8. Tree, Humpty Doo, N.T. 9. Fruit 10. Adult leaves and inflorescence

Queensland Silver Ash Ash, Silver Ash

Flindersia bourjotiana F. Muell.

Queensland silver ash is a medium-sized to tall tree attaining 35 m in height and 1 m in diameter. The trunk is not buttressed and is usually well formed and circular in cross-section.

Queensland silver ash has a limited distribution in northern Queensland between Mt Fox, south-west of Ingham, and Cooktown.

Soils are generally deep loams on metamorphics, granite and basalt.

This species grows in most northern Queensland rainforest types and is associated with a large number of rainforest tree species.

Related species: There are 15 species of *Flindersia* in Australia but the most closely related are *F. schottiana* and *F. xanthoxyla*.

Publication: *Fragm.* 9, 133 (1875). Type: Rockingham Bay, northern Queensland, J. Dallachy.

Names: Botanical—*Flindersia*, honours Capt Matthew Flinders R.N. (1774–1814) who commanded the *Investigator* which circumnavigated Australia mapping its coastline; *bourjotiana*, honours Dr A. Bourjot. Common—alludes to the Queensland occurrence and the silvery ash-like wood.

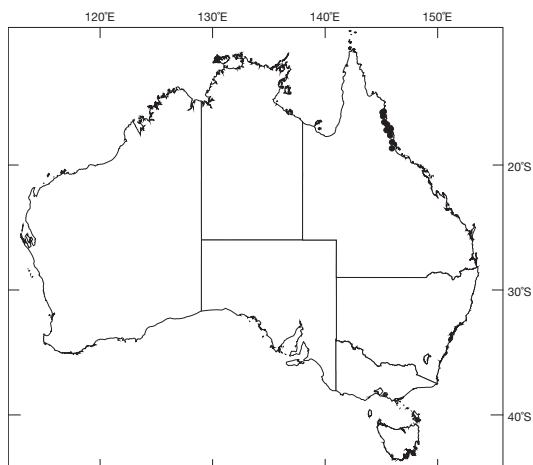
Bark: Nondescript, but characteristically marked by pale, horizontally elongated lenticels. The outer blaze is cream or yellowish, except for a thin red or purplish layer just inside the living bark.

Leaves: Cotyledons—shortly petiolate, depressed ovate to depressed obovate, emarginate, about 0.7×2.5 cm; cotyledons are held vertically on either side of the stem. Seedling—first 2–3 pairs of leaves simple and opposite, subsequent leaves spirally arranged and unifoliolate; petioles about 1–4 cm long; elliptical, $8\text{--}11 \times 3.5\text{--}5$ cm, finely hairy, eventually spirally arranged and imparipinnate. Numerous oil glands present. Adult—opposite, imparipinnate or occasional leaves paripinnate, 9–33 cm long; leaflets 2–4 pairs, densely oil-dotted, partly pubescent on the underside, elliptic to lanceolate, $5.5\text{--}17 \times 1.5\text{--}4.8$ cm, petiolules of the lateral leaflets 0.15–0.4 cm long. Lateral veins 12–17 pairs.

Inflorescences: Terminal, panicate. Flower buds globular, flowers 0.6–1 cm long. Sepals broadly ovate to suborbicular, 0.1–0.2 cm long. Petals white or greenish white, 0.5–0.95 cm long. Stamens 5, alternating with the petals, filaments arched; staminodes 5, shorter than and alternating with the stamens. Ovary 5-celled with 6 ovules in each cell. Flowers Jan.–Dec.

Fruits: Five-valved capsules about 7–15 cm long, each boat-shaped valve separating completely from its neighbour. Exocarp muricate, excrescences to 0.4 cm long. Seeds winged at both ends, about 5.5 cm long, hypocotyl lateral.

Wood: Sapwood susceptible to *Lyctus* attack; heartwood straw-coloured to almost white sometimes greyish, silvery or slightly tawny, grain mostly straight, sometimes interlocked, ribbon-like figure, tough and strong, density $510\text{--}740 \text{ kg m}^{-3}$. The timber works and bends well and takes a good polish. Suitable for cabinetwork and the production of rotary and sliced veneers. Not durable in the ground but lasts reasonably well when exposed to the weather.



Climate: Altitudinal range: near sea level to 1200 m; hottest/coldest month: $29\text{--}32^\circ\text{C}/10\text{--}17^\circ\text{C}$; Frost incidence: low (except upland sites); Rainfall: 1100–3800 mm per year, summer max.

Distinctive features: Horizontally elongated lenticels, cream blaze with a thin red or purplish layer in the outer part of the living bark, leaflets often pubescent on the underside, white flowers and capsules with a muricate outer surface.



Flindersia bourjotiana 1. Adult leaves 2. Flower (S.E.M.) 3. Fruits closed 4. Fruit open 5. Seeds with wings at both ends 6. Flowering branch 7. Pair of cotyledons 8. Seedling with one remaining cotyledon 9. Tree 10. Bark

Queensland Maple Maple

Flindersia brayleyana F. Muell.

Queensland maple is a medium-sized to tall tree attaining 40 m in height and 2.5 m in diameter. The trunk is not buttressed and the stem is usually well formed and circular in cross-section.

Queensland maple is restricted in its distribution to northern Queensland where it ranges between Townsville in the south and the Windsor Tableland in the north.

Soils vary from skeletal to deep loams on metamorphics, granite and basalt but the tree reaches its best development on basalt and granite.

Queensland maple grows in a variety of rainforest types and is associated with a large number of rainforest tree species.

Related species: There are 15 species of *Flindersia* in Australia but the most closely related to *F. brayleyana* are *F. laevicarpa* and *F. brassii*.

Publication: *Fragm.* 5, 143 (1866). Type: Herbert River area, northern Queensland, J. Dallachy.

Names: Botanical—*Flindersia*, see notes under *F. bourjotiana*; *brayleyana*, honours Professor E.W. Brayley, a member of the Royal Society, London. Common—alludes to the Queensland occurrences and the superficial resemblance of the wood to that of American maple (*Acer* spp.).

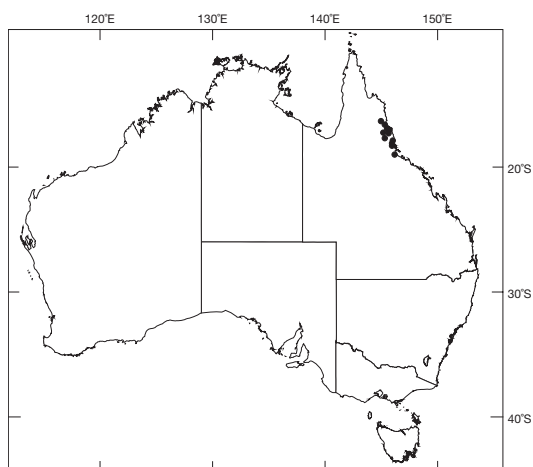
Bark: Usually shallowly fissured on large trees and often slightly flaky, particularly on the larger trees. The lenticels are pale and often arranged in vertical lines in shallow fissures in the bark. The outer blaze is pink to red and fibrous in texture.

Leaves: Cotyledons—opposite, shortly petiolate, linear-lanceolate, about 4.5–5.5 × 1.5–2 cm, base auriculate. Seedling—spirally arranged, initially simple (unifoliate); petioles about 1–5 cm long; elliptical, acute, 8–22 × 3.5–8.5 cm, glabrous, green, discolorous, becoming trifoliate and finally imparipinnate; numerous oil glands present. Adult—opposite or sub-opposite, paripinnate, 27–45(75) cm long; leaflets 3–5 pairs; petiolules 1–2.5 cm long; broadly elliptic to ovate-elliptic, mostly unequal sided, 8–18.5 × 3.3–7.5 cm. Lateral veins 8–12 pairs and densely oil-dotted.

Inflorescences: Terminal and in the upper leaf axils, panicate. Flower buds globular, flowers 0.3–0.4 cm long. Sepals ovate-triangular, about 0.5 mm long. Petals creamy white, 0.25–0.35 cm long. Stamens 5, alternating with the petals, filaments arched, staminodes 5, shorter than and alternating with the stamens. Ovary 5-celled, each cell containing 2 ovules. Flowers Nov.–Dec.

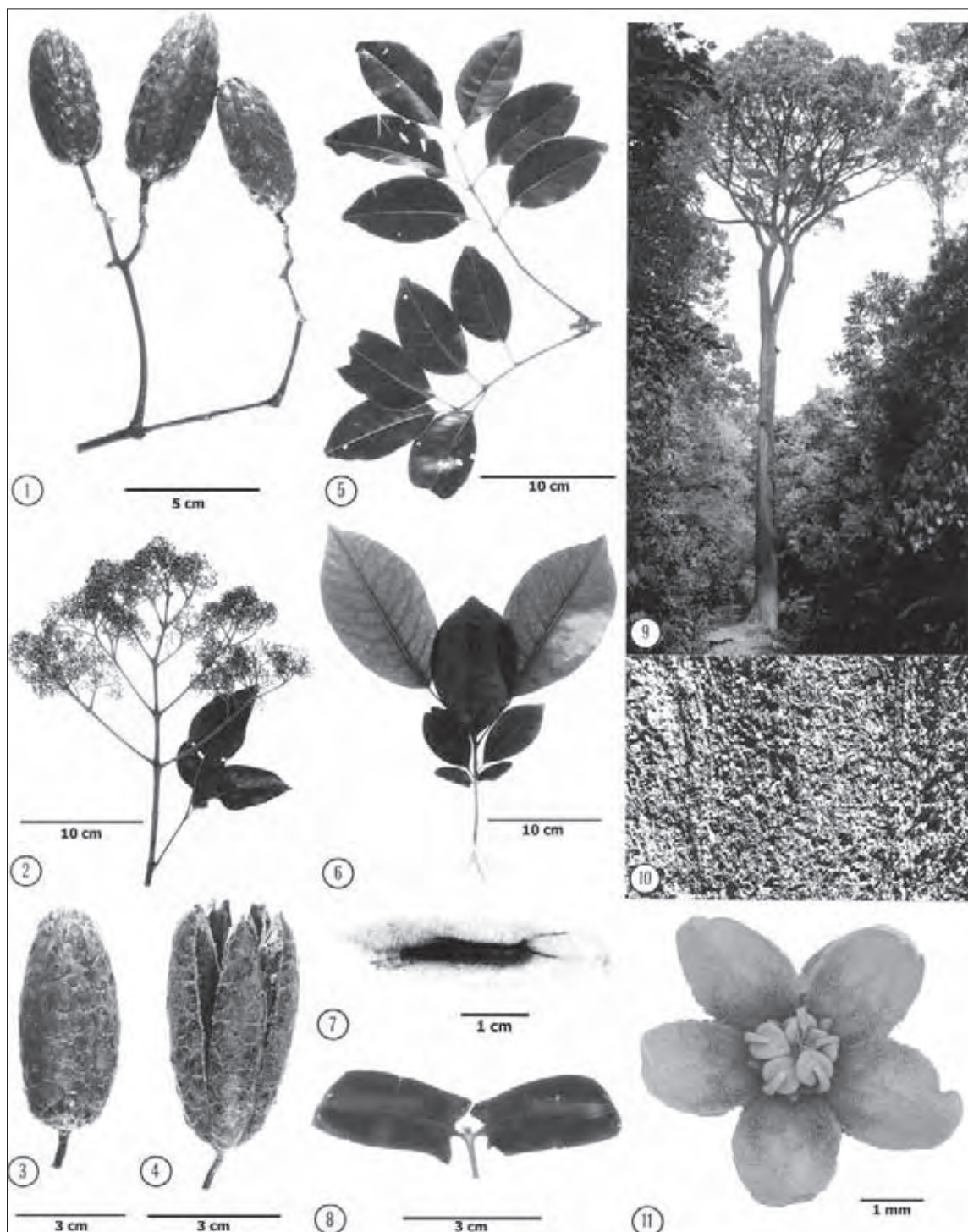
Fruits: Five-valved capsules about 6–10 cm long, each boat-shaped valve separating completely from its neighbour. Exocarp glabrous, areolate or almost smooth at maturity. Seeds winged at both ends, 4.5–6 cm long, hypocotyl terminal.

Wood: Sapwood not susceptible to *Lyctus* attack; heartwood brownish pink to flesh-pink, uniform in texture, grain often wavy, sometimes interlocked, figure enhanced by natural lustre, density 450–620 kg m⁻³. Durability in the weather unknown, not durable in contact with the ground. Wood often decoratively figured with coarse stripe figure. A very good cabinet timber that works and polishes well. Very suitable for the production of rotary or sliced veneers.



Climate: Altitudinal range: near sea level to 1200 m; hottest/coldest month: 29–32°C/10–17°C; Frost incidence: low (except upland sites); Rainfall: 1100–3800 mm per year, summer max.

Distinctive features: Slightly fissured bark, pink or red blaze; opposite, paripinnate, oil-dotted mature leaves; cream flowers and capsules with a nearly smooth outer surface.



Flindersia brayleyana 1. Fruits 2. Inflorescence 3. Fruit closed 4. Fruit open 5. Adult leaves 6. Seedling 7. Seed with wing 8. Cotyledons 9. Tree, near Atherton, Qld 10. Bark 11. Flower (S.E.M.)

Queensland Maple Silkwood, Maple Silkwood

Flindersia pimenteliana F. Muell.

Queensland maple is a medium-sized to tall tree attaining 40 m in height and 2.2 m in diameter. The trunk is not buttressed and the stem is usually fairly straight. The butt is often defective, being prone to a white pocket rot.

Queensland maple has a limited distribution in northern Queensland between near Townsville in the south and Cooktown in the north. The species also occurs over a wide area in New Guinea.

Soils vary from skeletal to deep loams on metamorphics, granite and basalt. The species probably reaches its best development on basalt but it occurs more frequently on metamorphics and granite.

This species grows in most northern Queensland rainforest types and is associated with a large number of rainforest tree species.

Related species: There are about 15 species of *Flindersia* in Australia. *F. unifoliolata* is now regarded as a form of *F. pimenteliana*.

Publication: *Fragm.* 9, 132 (1875). Type: Rockingham Bay, northern Queensland, J. Dallachy.

Names: Botanical—*Flindersia*, see notes under *F. bourjotiana*; *pimenteliana* honours J.M. de O. Pimentel. Common—see notes under *F. brayleyana*.

Bark: Nondescript, rarely flaky, with prominent rusty-red lenticels on healthy trees. Outer blaze pink to red and fibrous in texture.

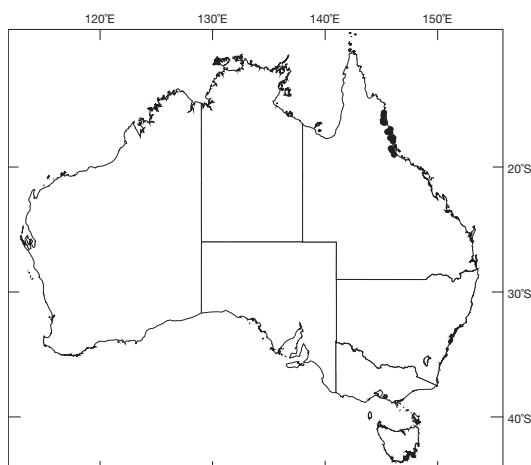
Leaves: Cotyledons—shortly petiolate, reniform, about 1–2 × 3–4 cm. Seedling—spirally arranged; petioles 3–12 cm long; trifoliolate, later imparipinnate or occasionally bipinnate; petiolules 0.3–1 cm with the terminal petiolule slightly longer; leaflets, ovate, acuminate, 5–9 × 2–3 cm, glabrous. Stems glabrous. Adult—opposite or subopposite, imparipinnate (occasional leaves paripinnate) 8–34 cm long, oil dots present or absent, leaflets 1–3 occasionally up to 5 pairs; petiolules 0.35–1.1 cm on the unequal-sided lateral leaflets; elliptic to elliptic-oblong, 4.5–15.5 × 1.8–5.5, lateral veins 9–14 pairs.

Inflorescences: Terminal and in the upper leaf axils, paniculate. Flower buds globular, flowers 0.25–0.4 cm long. Sepals broadly ovate, 0.8–1.2 mm long. Petals red, 0.25–0.4 cm long. Stamens 5, alternating with the petals, filaments arched, staminodes, 5, shorter than and alternating with the stamens. Ovary 5-celled, each cell containing 4 ovules. Flowers Sept.–Feb.

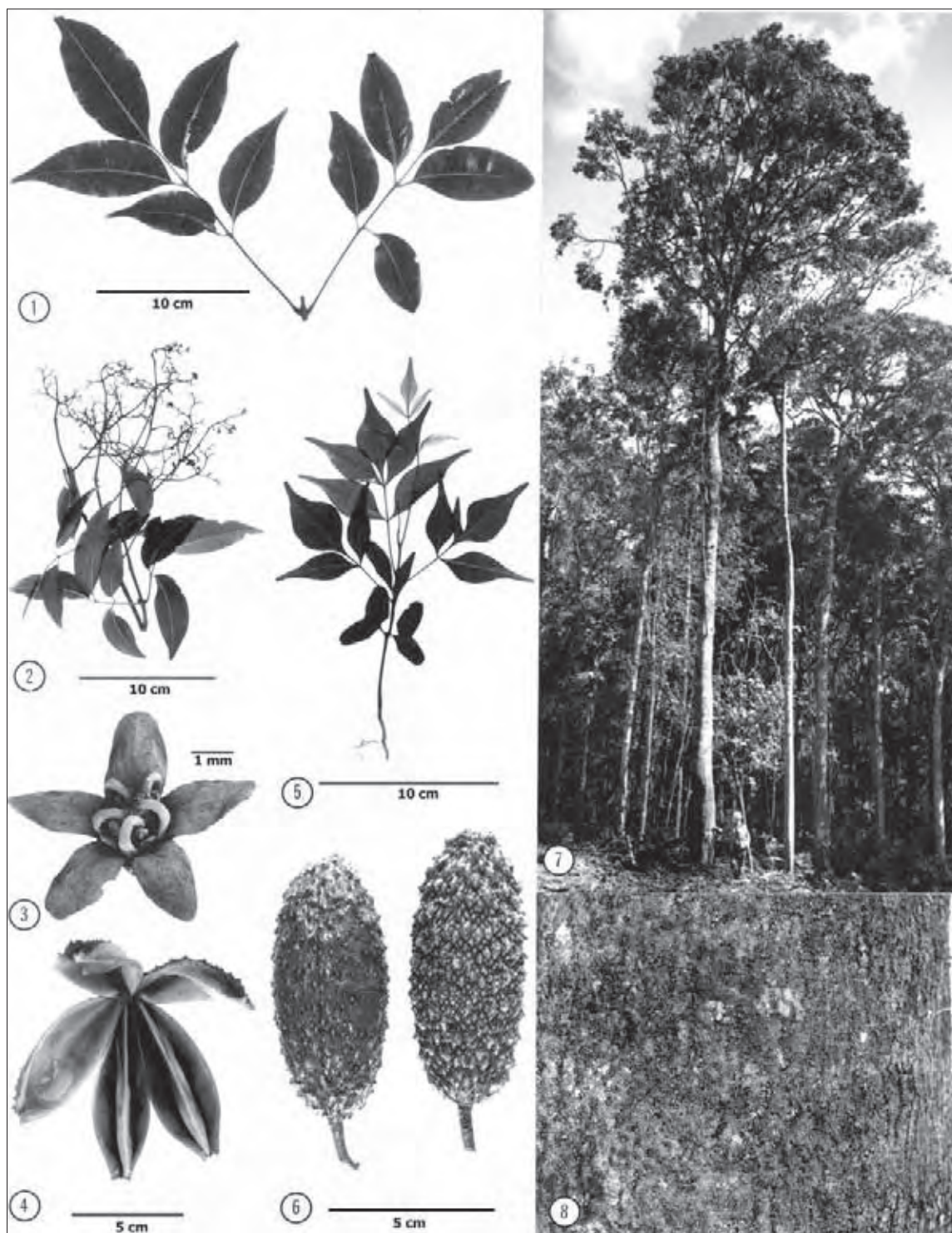
Fruits: Five-valved capsules about 5.5–11.5 cm long, each boat-shaped valve separating completely from its neighbour. Exocarp muricate, the excrescences densely crowded and up to 0.4 cm long. Seeds winged at both ends, about 4–6 cm long, hypocotyl lateral.

Climate: Altitudinal range: near sea level to 1200 m; hottest/coldest month: 29–32°C/10–17°C; Frost incidence: low (except upland sites); Rainfall: 1100–3800 mm per year, summer max.

Wood: As for *Flindersia brayleyana*. Wood tends to be darker, deep pink to reddish in colour, somewhat finer textured and heavier, density 580–675 kg m⁻³.



Distinctive features: Pink to red blaze, opposite imparipinnate leaves with few oil dots, flowers red and capsules with muricate exocarp.



Flindersia pimenteliana 1. Adult leaves 2. Flowering branch 3. Flower (S.E.M.) 4. Open fruit 5. Seedling with pair of cotyledons 6. Closed fruits 7. Tree 8. Bark

Sandalwood

Santalum spicatum (R. Br.) DC.

Sandalwood is typically a small tree 3–8 m tall and 0.1–0.3 m in diameter. The tree crown is greyish in appearance and rather umbrageous. The leaves in the crown are somewhat sparse and the irregular branching habit of the crown is conspicuous. Sandalwood trees are a root parasite on many species and two recognised common hosts are raspberry jam (*Acacia acuminata*) and mulga (*A. aneura*). The ground under the canopy of sandalwood trees is usually littered with hard-coated seeds shed in past seasons.

Sandalwood occurs in the drier inland areas of Western Australia and South Australia. In Western Australia the species extended originally from the south-eastern wheatfields area to the eastern goldfields and the Murchison. It is now rare in the wheatfields area and occurs in any quantity only in the eastern, Murchison and north-eastern goldfields. In South Australia it occurs in the Northern Flinders Ranges near Leigh Creek and Mt Serle and westward to Tarcoola and Ooldea.

Sandalwood grows on a wide range of soils from calcareous red loams to deep red sands in Western Australia, to saline loams in South Australia. The topography is almost flat although the species can grow on hillsides.

It occurs in a wide range of forest types from woodlands to open shrublands. Associated species, not necessarily parasitised by sandalwood, include mulga (*Acacia aneura*), gimlet (*Eucalyptus salubris*), York gum (*E. loxophleba*), belah (*Casuarina pauper*), pittosporum (*Pittosporum phillyreoides*) and the shrubs saltbush (*Atriplex vesicaria*), blue bush (*Maireana sedifolia*) and *Eremophila* spp.

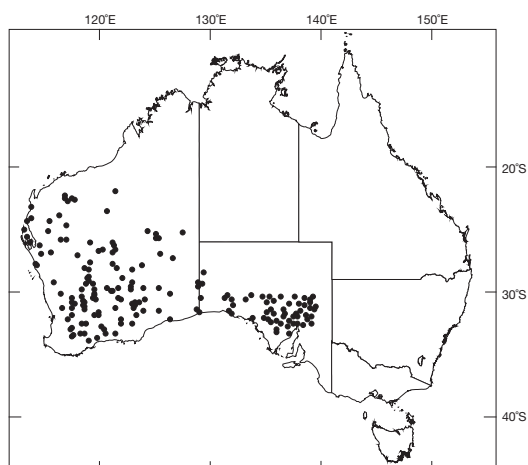
Related species: *Santalum* contains approximately 25 species occurring in Asia, Australia, Indonesia and the South Pacific Islands. Common Australian species are quandong (*S. acuminatum*), bitter quandong (*S. murrayanum*) and *S. lanceolatum*. The last species has longer perianth tubes and styles than the others, glaucous leaves and small purple fruits. *S. murrayanum* has minutely pitted endocarps and fine, pendulous foliage. *S. acuminatum* has yellowish-green leaves which are more pendulous and larger than sandalwood, and a distinctive rugosely pitted endocarp.

Publication: DC. *Prodr.* 14, 685 (1857). Type: South coast of Western Australia, R. Brown.

Names: Botanical—*Santalum*, from the Greek *santalón* (taken from the Arabic, sandal, the Indian sandalwood (*S. album*)); *spicatum*, from the Latin *spica* (point, flower-spike), perhaps in allusion to the inflorescence or narrow leaves. Common—similar to the generic name in derivation.

Bark: Rough, fibrous and furrowed on the lower parts of the tree but the upper limbs grey or blue and smooth.

Leaves: Cotyledons—2 or 3, linear, about 1.3 × 0.2 cm, blunt ended. Seedling—opposite to subopposite, shortly petiolate, lanceolate, to 3 × 1 cm, with a small bulbous portion near the stem base. Adult—erect, opposite; petioles to 0.5 cm long; narrow lanceolate, 3–6 × 1–2 cm, dull grey-green, coriaceous.



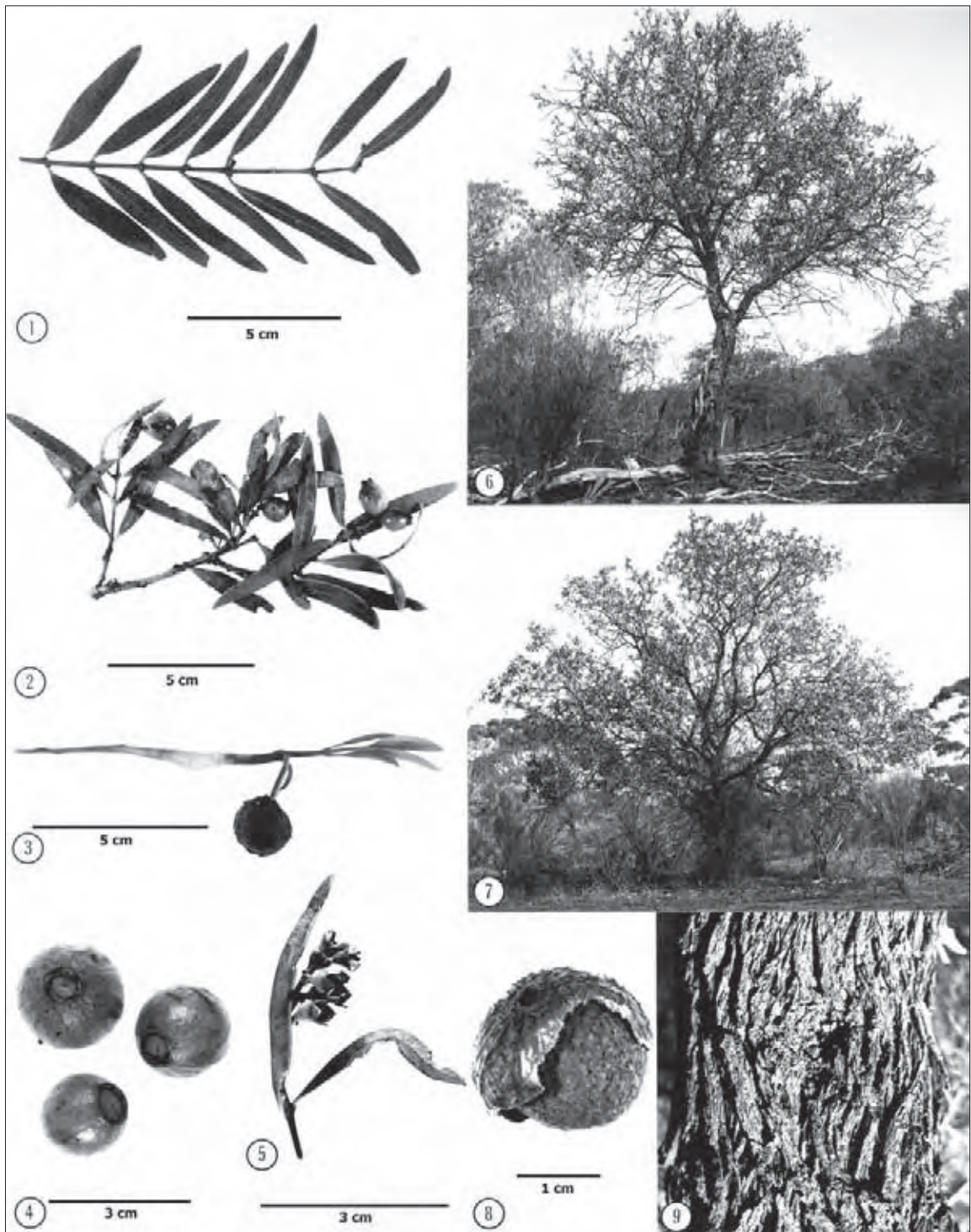
Inflorescences: Axillary and terminal panicles. Flowers small, green and red inside, fragrant. Each flower bisexual, subtended by a small caducous bract. Perianth in 4 fleshy segments, each segment bearing a tuft of hairs behind the stamens. Anthers 2-celled, filaments short and incurved. Ovary inferior, torus short turbinate, almost entirely adnate to the ovary. Style with 2–3 stigmas.

Fruits: Drupes, orange-red when ripe, short peduncle. Exocarp is leathery, endocarp is smooth-surfaced, fruit is globoid to 2 cm diameter. Perianth and disc are persistent until the fruit is nearly ripe.

Wood: Pale sapwood; heartwood light to dark brown, very fine-textured, grain straight with oily feel and strongly aromatic, density 845–1085 kg m⁻³. Sandalwood is used for a variety of purposes. In powdered form it is used for the manufacture of joss sticks. The wood is used for carvings and the production of napkin rings, small boxes and fans. An aromatic oil can be distilled, mainly from tree butts and roots, which is used as a fixative for perfumes and in high-quality soaps. The wood is also an excellent fuel and has been used for firing brick kilns. Sandalwood is exported for use mainly by Buddhists in Taiwan, Hong Kong, Singapore, Malaysia and Thailand. Appearance and aroma of the wood is somewhat similar to dark-heart cypress pine (*Callitris* spp.). Sandal box (*Eremophilla mitchellii*)—also called bastard sandalwood—resembles sandalwood in terms of its fine texture and the odour of the burning wood, however, it is a poor substitute. Historical aspects on the use and research on sandalwood in Western Australia is given by Loneragan (1990).

Climate: Altitudinal range: near sea level to 500 m; hottest/coldest month: 32–38°C/3–7°C; Frost incidence: low to moderate (up to 10 per year); Rainfall: 150–500 mm per year, mainly winter max.

Distinctive features: A parasitic species with dull grey-green leaves, aromatic wood, orange-red fruit and a smooth-surfaced endocarp.



Santalum spicatum 1. Adult leaves 2. Adult leaves and immature fruits 3. Seedling with swollen root and cotyledons still attached to seed 4. Fruits, mature 5. Immature flowers 6. Tree, near Coolgardie, W.A. 7. Tree, near Kalgoorlie, W.A. 8. Fruit with half leathery exocarp removed to reveal smooth-surfaced but hard endocarp 9. Bark

Native Tamarind

Diploglottis cunninghamii (Hook.) Hook. f. ex Benth.

Native tamarind is usually a medium-sized straight tree, attaining a height of 20 m, or sometimes 35 m, and a stem diameter of 0.75 m. The species is most conspicuous in rainforests with its umbrella-shaped crown and very large compound leaves which are dark green above and rusty-brown below. The stem is often fluted at the base and at times the fluting extends some distance up the bole.

This species occurs in rainforests between the Illawarra region in southern New South Wales to near Nambour, Queensland. Its best development in the rainforests of the Macpherson Ranges. In Queensland it extends west to the Bunya Mountains.

Native tamarind grows in a wide range of sites from valley sides to gullies and plateaux. The species is found on a wide range of soils such as red clay loams derived from basalts, and podsolic soils derived from sedimentary and acid volcanic rocks. It also occurs on enriched alluvia usually in moist gullies in tall open forests.

Native tamarind occurs mainly in subtropical (complex notophyll vine forests) and warm temperate rainforests (simple notophyll vine forests). It grows in association with a wide range of species and some of the more common are booyongs (*Argyrodendron actinophyllum* and *A. trifoliolatum*), red cedar (*Toona ciliata*), giant stinging-tree (*Dendrocnide excelsa*), black bean (*Castanospermum australe*), red ash (*Alphitonia excelsa*), flooded gum (*Eucalyptus grandis*) and tallowwood (*E. microcorys*).

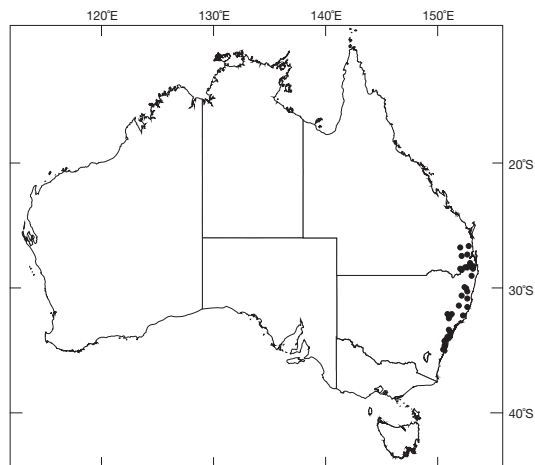
Related species: There are 8 endemic species of *Diploglottis* in Australia. *D. campbellii* is a rare distinctive plant, which has smaller almost glabrous leaves and large fruits up to 7 cm diameter. *Diploglottis macrantha*, which occurs on Cape York Peninsula, north Queensland, is similar to *D. cunninghamii* but is a smaller tree (4 m tall) and has larger flowers.

Publication: *Fl. Austral.* 1, 454 (1863). Type: From a cultivated plant at Kew (seed introduced in 1825), England.

Names: Botanical—*Diploglottis*, from the Greek *diploos* (double), plus *glotta* (tongue), possibly alludes to the 2 tongue-like glands at the base of the petal; *cunninghamii*, honours A. Cunningham (1791–1839), an explorer and botanical collector mainly in eastern Australia. Common—presumably after the other tamarind (*Tamarindus indica* L.) whose fruit (although a legume) has a similar pleasant acidic taste, particularly the inside pulp.

Bark: Dark grey or greyish brown, usually smooth on small trees but larger trees sometimes have a rough pimpled surface, underbark dark brown, outer surface of live bark pinkish-brown with green vertical stripes.

Leaves: Seedling—apparently spirally arranged; petioles 0.3–0.5 cm long; first few leaves, simple, entire, ovate-elliptic, 6–15 × 3–7 cm, green, discolourous, hairy both surfaces, later leaves (about 10th onwards) are imparipinnate with 5–7 leaflets; venation prominent both surfaces, raised beneath. Adult—alternate; petioles about 5–8 cm long; pinnate, sometimes exceeding 60 cm in length consisting of 8–12 large, alternate,



entire leaflets, oblong elliptical to ovate-lanceolate, 13–30 cm long, rounded or bluntly pointed at the apex, unequal sided at the base with petiolules about 0.3–0.6 cm long and thick; both surfaces covered with soft rusty brown hairs, but usually denser on the undersurface. The leaflets are commonly curved and keeled and rough and leathery to feel. Venation distinct both surfaces, but more prominently raised below.

Inflorescences: Large stiff panicles about 40 cm long, arising from the axils of the upper leaves and projecting upright above the tree canopy. Flowers about 0.5 × 0.5 cm on pedicels about 0.4 cm long. Calyx 5 lobed, brown and densely hairy. Petals 5, white, thin, orbicular, about 0.3 cm long, with two inner, hairy, scale-like structures adnate to the base of the petal and about as long as the petal, the outer sides of each scale bearing a single adnate structure which has at its summit a glandular yellow structure of undetermined function. Stamens 8, hairy at base of filament, inserted mostly within an orange horse-shoe-shaped disc, shorter or longer than the petals, anthers basified. Ovary hairy and style apparently very reduced. Flowers Sept.–Nov.

Fruits: Capsules, brown, hairy, 2–3 globular lobes 1–1.5 cm diameter, each containing a seed enclosed by an orange-yellow juicy pulp (aril) of a pleasant acid flavour. Mature Dec.–Jan.

Wood: Sapwood pale, susceptible to *Lyctus* attack; heartwood light cream to yellowish brown, darker toward the centre, with wavy growth rings, moderately fine-textured, hard, fine-grained, basic density 395–715 kg m⁻³ (calculated air-dry density 480–865 kg m⁻³). The wood is suitable for flooring and case making but availability is limited.

Climate: Altitudinal range: near sea level to 1000 m; hottest/coldest month: 26–30°C/5–8°C; Frost incidence: low (except upland sites); Rainfall: 1000–2000 mm per year, summer max.

Distinctive features: This is a very distinctive and conspicuous rainforest tree with very large pinnate, rusty green foliage and orange-yellow juicy fruits. The arils of the fruit are occasionally used for jams and stews.



Diploglottis cunninghamii 1. Fruit dehiscing and exposing seed 2. Flower (S.E.M.) 3. Flowers 4. Inflorescence at bud stage 5. Tree, Dorrigo Mtn near Dorrigo, N.S.W. 6. Adult leaf 7. Fruiting branch 8. Tree, near Woolgoolga, N.S.W. 9. Bark 10. Seedling

Blush Tulip Oak Black Booyong, Blackjack, Crowsfoot Elm

Argyrodendron actinophyllum (F.M. Bailey) Edlin

Blush tulip oak is a tall tree attaining 50 m in height with a stem diameter of about 1.5 m. The bases of large trees are usually prominently buttressed. The crown is large and has a dark glossy green appearance. There are two subspecies, the typical and subsp. *diversifolium*.

Subsp. *actinophyllum* occurs from Gloucester, New South Wales, to near Gympie, Queensland. In Queensland the main distribution is in the mountain ranges south of Brisbane and with a limited area in the D'Aguilar and Blackall Ranges. In New South Wales the main occurrence is in the McPherson Ranges and Dorrigo Plateau areas. Subsp. *diversifolium* occurs in Queensland from Calen to Carmila in the Mackay area and also in the Paluma Ranges near Townsville.

Blush tulip oak typically prefers well-drained sites on the sides of mountains, or on plateaux. Soils are normally enriched podsols or alluvia but the species does occur on red clays derived from basalt.

The species occurs usually in subtropical rainforests (complex notophyll vine forests) but also in riverine and dry rainforests. It is typically co-dominant with species such as brown tulip oak (*A. trifoliolatum*), pigeonberry ash (*Cryptocarya erythroxylon*), red cedar (*Toona ciliata*) and yellow carabeen (*Sloanea woollsii*). Some sites include coachwood (*Ceratopetalum apetalum*) and crapple (*Schizomeria ovata*).

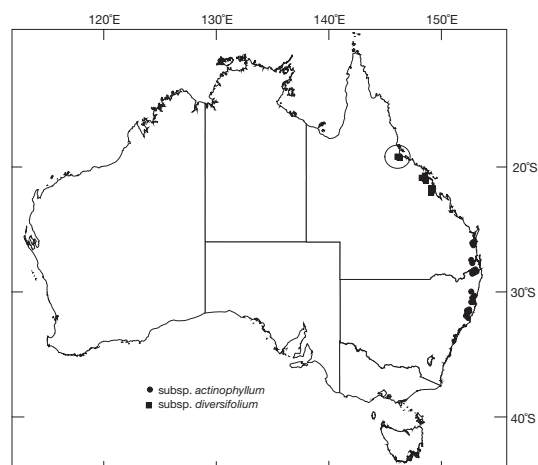
Related species: Of the *Argyrodendron* species in Australia, the 4 described ones include *A. polyandrum*, brown tulip oak (*A. trifoliolatum*) and red tulip oak (*A. peralatum*); there are also 3 or 4 undescribed ones. The above 3 described species are usually trifoliolate, with *A. peralatum* having fruiting carpels densely covered with short protuberances (trichomes). *A. actinophyllum* differs from other Australian argyrodendrons in that the leaves are 5(–9) foliolate.

Publication: Subsp. *actinophyllum* *New Phytol.* 34, 10 (1935). Type: Not determined. Subsp. *diversifolium* L. S. Sm.: *Contr. Qld Herb.* 6:17 (1969) Type: Eungella Range, Bee Creek and Crediton, M.S. Clemens.

Names: Botanical—*Argyrodendron*, from the Greek *argyros* (silver), plus *dendron* (tree), probably in allusion to the undersides of the leaves which are white or silvery in some species; *actinophyllum*, from the Greek *aktis* (ray), plus *phyllum* (a leaf), alluding to the leaflets radiating from the apex of the leaf stalk. Common—alludes to the wood colour and texture, being reminiscent of the wood of *Quercus* spp.

Bark: Finely fissured, tessellated and shed in small rectangular pieces. The colour is grey or more frequently brown to almost black. When blazed the underbark is dark red to pinkish-brown towards the outer surface and nearly white towards the sapwood.

Leaves: Cotyledons—at ground level, ovate-elliptical, 1–1.2 × 0.6–0.8 cm, fleshy, mucilage exudes as seed germinates and seedcoat adheres to cotyledon after germination. Seedling—first pair opposite, simple, petiolate to 0.1 cm long, ovate, cordate, acuminate, becoming alternate, petiolate to 0.3–1 cm long with a leaf joint, ovate-elliptical, 4–11 × 1–3 cm, glabrous,



dark glossy above, discolorous; venation reticulate both surfaces. Adult—alternate, petiolate to 5–15 cm long, 5(–9) foliolate; leaflets entire, petiolules to 1–2 cm long, elliptical to lanceolate, attenuate, acuminate, 8–13 × 2–3 cm, glabrous, dark glossy green, discolorous; venation visible both surfaces, undersides of leaflets with prominent hollow domatia between midribs and secondary veins (*actinophyllum*) or undersides scaly with domatia absent (*diversifolium*).

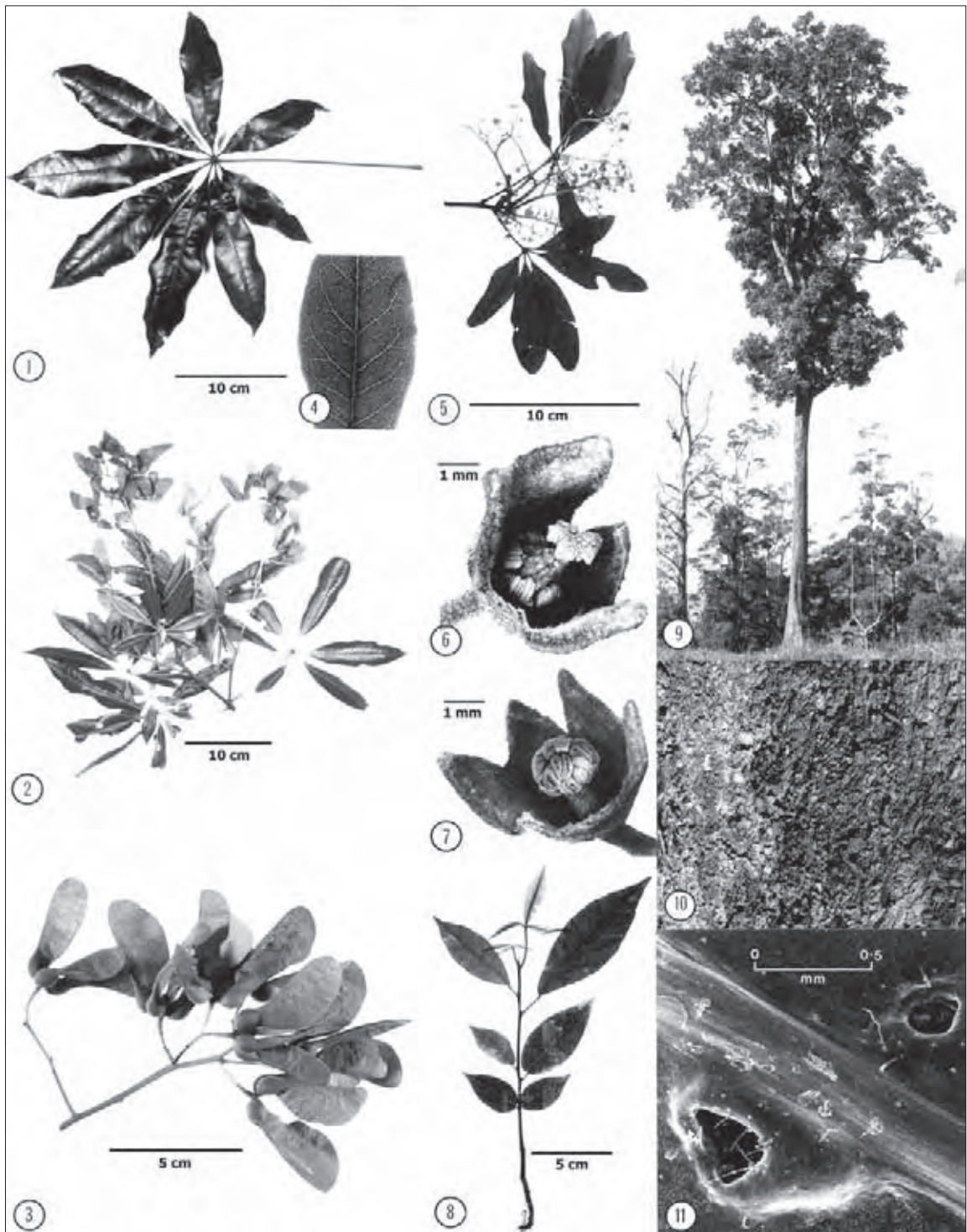
Inflorescences: Axillary panicles of unisexual flowers with both male and female flowers on the same tree. Flowers campanulate, pedicels and flowers clothed in scurfy scales. Calyx tubular, cream coloured, 5 triangular lobes, about 0.4–0.7 cm long, petals absent, stamens 15. Stamens in male flowers are united into a column with 10 or more anthers at the top. Female flowers have 3–5 distinct sessile, pilose carpels each with 1 ovule. Styles single, short. Staminalodes 15, clustered at the base of the carpels. Flowers Mar.–Apr.

Fruits: Ripe carpels are soft, leathery, smooth, clothed with brownish scales, ovoid, 0.5–1 cm diameter with a broad, soft, thin, opaque wing 2–6 × 1–2 cm at one end. Fruiting trees are conspicuous with large dense clusters of reddish-brown fruits in the tree crowns. Mature Sept.–Oct.

Wood: Sapwood, often very wide, pale, very susceptible to *Lyctus* attack; heartwood, light brown to warm pink, grain straight, coarse texture, density 645–935 kg m⁻³. The quarter-cut face has a typical oak-like appearance due to the large size of the rays. The wood is very prone to surface checking and thus slow initial drying is required; used for plywood, furniture, flooring, panelling, handles and building framework.

Climate: Altitudinal range: 30–900 m but usually above 500 m; hottest/coldest month: 26–30°C/2–6°C (*actinophyllum*) 28–30°C/8–12°C (*diversifolium*); Frost incidence: low, mainly in the south of its range; Rainfall: 1000–1500 mm per year, mainly summer max.

Distinctive features: A rainforest tree, compound leaves with 5(–9) leaflets radiating from the apex of the petiole, large single-winged fruits.



Argyrodendron actinophyllum 1. Adult leaf 2. Adult leaves and immature fruits 3. Mature fruits 4. Adult leaf venation 5. Inflorescence 6. Female flower (S.E.M.) 7. Male flower (S.E.M.) 8. Field seedling 9. Tree, Wiangaree State Forest, N.S.W. 10. Bark 11. Domatia on adult leaf (S.E.M.)

Red Tulip Oak Tulip Oak

Argyrodendron peralatum (Bailey) Edlin ex. Boas

Red tulip oak is a medium to tall well-formed tree attaining 55 m in height and 1.5 m diameter. The buttressed stem is usually straight and evenly tapered.

This species has a restricted distribution in northern Queensland between Tully and Cooktown.

Soils vary substantially but the species reaches its best development on deep well-drained loams on granite and basalt.

Red tulip oak grows in a variety of rainforest types and is associated with a large number of rainforest tree species.

Related species: There are 3 or 4 undescribed and 3 other described species of *Argyrodendron* in Australia. The described species are *A. polyandrum*, brown tulip oak (*A. trifoliolatum*) and blush tulip oak (*A. actinophyllum*); the first 2 have trifoliolate leaves and smooth-surfaced samaras, while *A. actinophyllum* has 5(–9)-foliolate leaves and smooth-surfaced samaras.

Publication: *The Commercial Timbers of Australia*, 228 (1947). Type: Upper Barron River, northern Queensland, J.F. Bailey.

Names: Botanical—*Argyrodendron*, from the Greek *argyros* (silver), plus *dendron* (a tree), probably in allusion to the underside of the leaves which are white or silvery on some species; *peralatum*, from the Latin *pers* (very), plus *alatus* (winged), referring to the well-developed wing on the fruits. Common—alludes to the wood colour and texture; being reminiscent of the wood of *Quercus* spp.

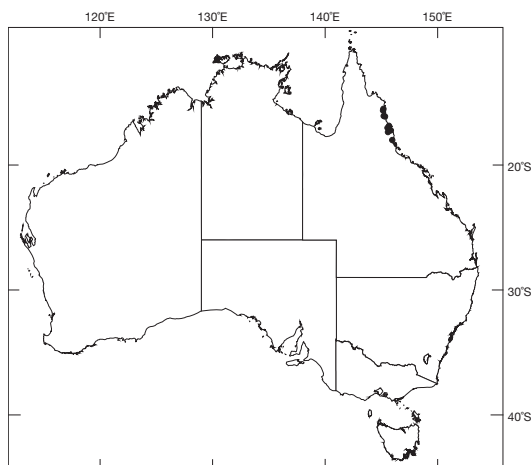
Bark: Flaky or tessellated, occasionally somewhat fissured and the outer blaze pink to red usually marked by paler longitudinal stripes.

Leaves: Cotyledons—opposite, near ground level, very shortly petiolate, cordate to hastate, about 1–1.5 × 0.8–1.5 cm, thick, fleshy. Seedling—first pair simple and opposite, subsequent leaves spirally arranged, simple, eventually becoming trifoliolate. Adult—spirally arranged; petioles about 4–6 cm long; trifoliolate; leaflets, lanceolate, 9–16 × 1.5–4.5 cm, petiolules about 0.3–1 cm long; underside of leaflets densely clothed with small white or silvery scales. Lateral veins about 20–35 pairs but very difficult to count because of the covering of scales. Midrib depressed on the upper surface.

Inflorescences: Panicle in the upper axils but not truly terminal, flower buds globular. Flowers cream, broadly campanulate, densely stellate pubescent inside and out, calyx lobes 5, petals absent. Stamens about 15, aggregated into a spherical head. Ovary consisting of 5 distinct carpels each containing 1 ovule. Styles short, stigmas broad and radiating. Flowers Mar.–Apr.

Fruits: Samaras, 8–13 × 3–5 cm, the lower globular part (containing the embryo) about 1–1.5 cm diameter and covered with short trichomes. Seeds, when germinating, exude mucilaginous material.

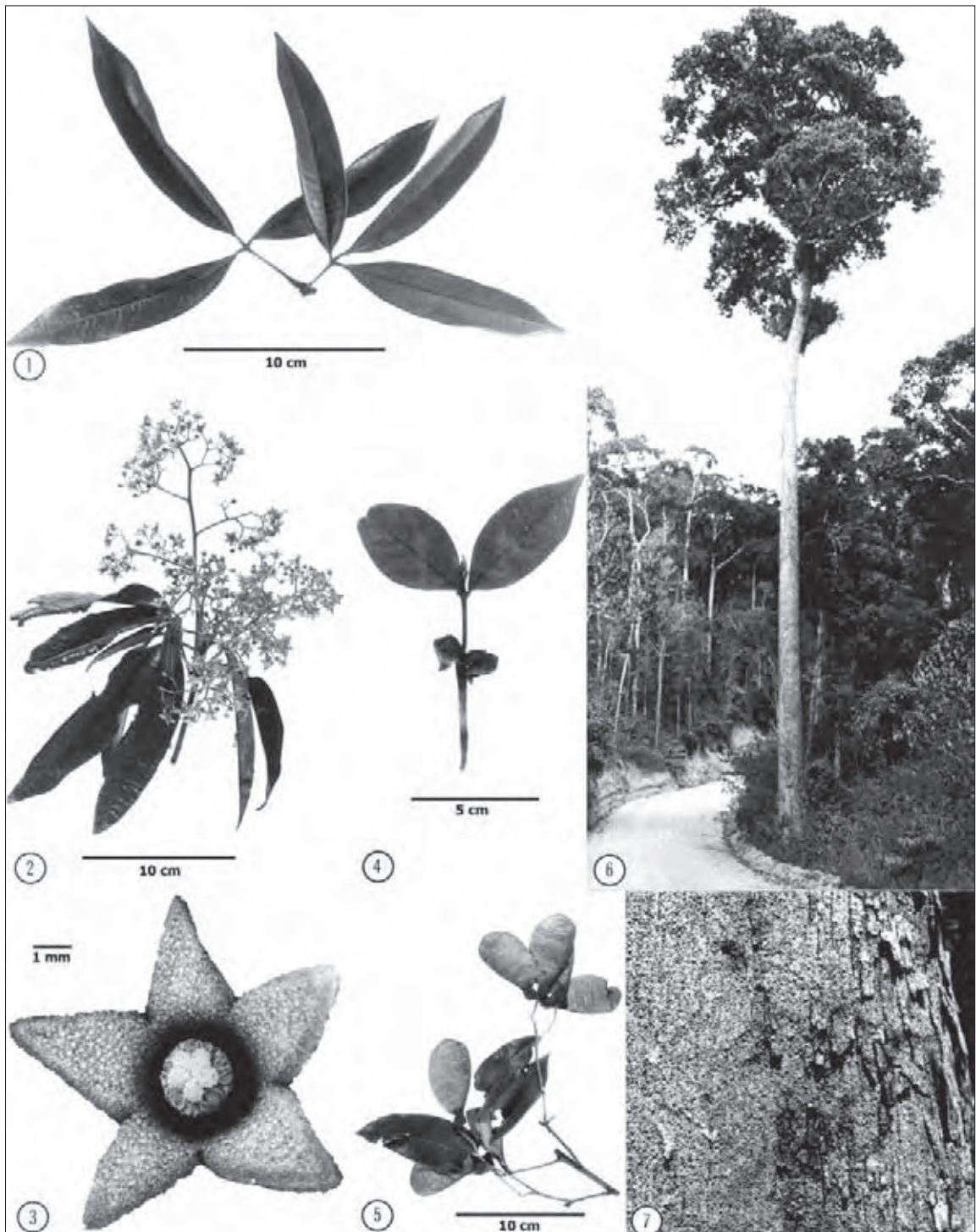
Wood: Sapwood susceptible to *Lyctus* attack; heartwood pink to reddish brown with a wide zone of intermediate wood, usually decoratively figured with a fine mottle on quartersawn surfaces with wavy markings on the backsawn surface, grain straight and coarse-textured, not durable, moderately strong,



density 640–890 kg m⁻³. Dresses well particularly with machine tools and is very useful for structural purposes and decorative floors. Peels well and produces a decorative veneer, and also has good moulding and turning properties.

Climate: Altitudinal range: near sea level to about 900 m; hottest/coldest month: 30–32°C/15–20°C; Frost incidence: low; Rainfall: 1250–3800 mm per year, summer max.

Distinctive features: Straight stem, conspicuous buttresses, trifoliolate leaves, leaflets white or silver on the underside, fruit covered with trichomes on the basal section.



Argyrodendron peralatum 1. Adult leaves 2. Inflorescence and adult leaves 3. Flower (S.E.M.) 4. Seedling with cotyledons 5. Fruits 6. Tree, Windsor Tableland, north-west of Mossman, Qld 7. Bark

Flame Tree Illawarra Flame Tree

Brachychiton acerifolius (A. Cunn. ex G. Don) Macarthur

Flame tree is a tall tree attaining 35 m in height and 0.7 m in diameter. The stem is usually cylindrical but may be slightly flanged at the base and gives a characteristic hollow sound when tapped. The leaves are usually deciduous when the tree is flowering and reappear after flowering. One of Australia's most beautiful flowering trees and planted widely as an amenity plant. Because flowering only accompanies leaf-fall, the crowns of some trees that are not fully deciduous may consist of patches of leafy and flowering branches.

This species occurs between Wollongong, New South Wales, and Gympie, Queensland. There are scattered occurrences north of Gympie then it is again common between Ingham and Cooktown, Queensland. Disjunct stands include near Proserpine and along the banks of the Claudie River in northern Queensland.

Flame tree prefers sheltered sites on mountain and river valleys while in northern Queensland it is common on the coastal lowlands around Cairns. It grows on deep loamy soils.

The species occurs in rainforests, mostly in subtropical rainforests often with blush tulip oak (*Argyrodendron actinophyllum*), tamarind (*Diploglottis cunninghamii*), red carabeen (*Geissois benthamiana*), crabapple (*Schizomeria ovata*) and various figs (*Ficus* spp.).

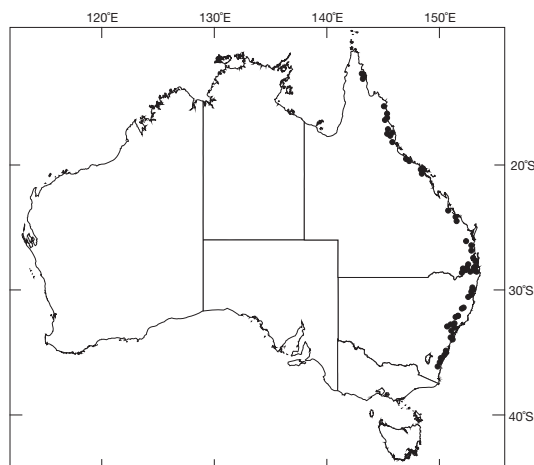
Related species: There are 31 species of *Brachychiton* of which 29 are endemic to Australia (Guymner 1988). They occur in all States except Tasmania. Only *B. acerifolius* and *B. discolor* occur in rainforests. The genus is characterised by boat-shaped follicles and the swollen trunks of some species. *B. acerifolius* is closely related to *B. discolor* which occurs from Dungog, New South Wales, to central coastal Queensland (Mackay). It differs in the larger (up to 5 cm long), deep pink hairy flowers, the presence of nectary scales in the flowers, and the downy hair on the leaf undersides.

Publication: *Cat. British Sect. Paris Uni. Exhib.* 116 (1855). Neotype: Illawarra?, without date, A. Cunningham s.n.

Names: Botanical—*Brachychiton*, from the Greek, *brachys* (short), plus *chiton* (tunic), in allusion to the short bristles surrounding the seed in the fruit; *acerifolius*, from the Latin *acer* (maple tree), plus *folium* (leaf), in allusion to the similarity of the leaves of this species to that of the European maple (*Acer saccharum*). Common—'flame' alludes to the brilliant display of red flowers at flowering time.

Bark: Greyish brown and fissured or wrinkled on larger trees. Blaze reveals a white or almost brown outer bark and a white to pale yellow sapwood. The inner bark is composed of lacelike fibres, used traditionally by Aborigines for ropes and fishing nets.

Leaves: Cotyledons—petioles 1–1.5 cm long; oval, 3.5–5 × 3–3.5 cm, dark green and glossy. Seedling—first pair alternate, cordate, about 8–11 × 4–7 cm, glossy dark green above, paler underneath, later pairs becoming 3 to 5-lobed, stem and petioles sparsely covered by short white hairs, venation reticulate and raised on the lower surface. Adult—large and alternately arranged on glabrous branchlets, petioles to 14 cm



long, slender. Leaf blades are variable in shape on younger trees, deeply 5 to 7-lobed, palmate, 10–20 cm in length; leaves on older, larger trees are entire and either rhomboid or ovate in shape; the palmate venation may be still apparent. Leaves are coriaceous, glossy and glabrous on both sides.

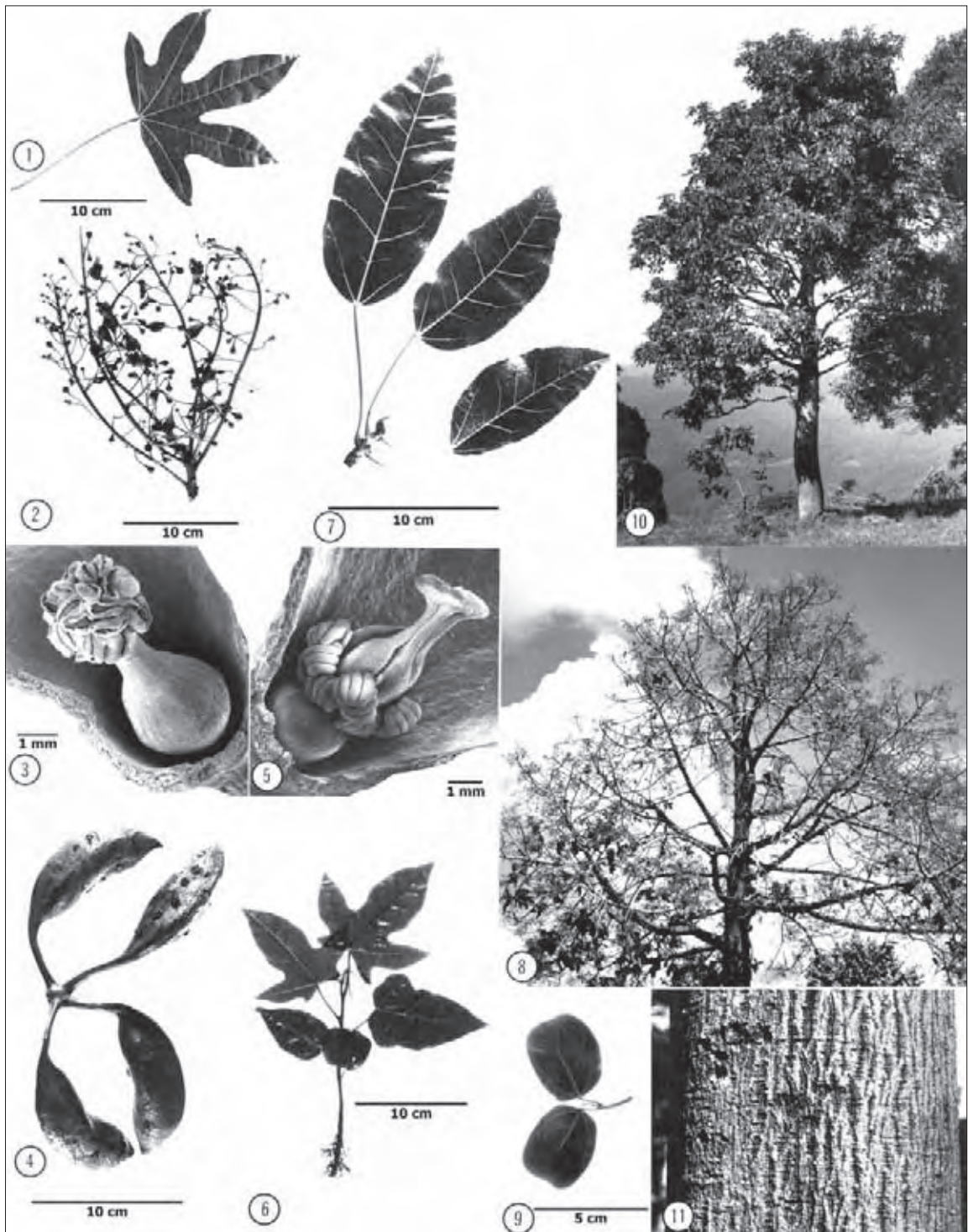
Inflorescences: Loose axillary panicles up to about 40 cm long; flowers unisexual; male and female flowers frequently on the same tree. Flowers campanulate and 2–3 cm long, on pedicels 0.5–2 cm long. Calyx petaloid, united and tubular below, consisting above of mostly 5 or occasionally 6 short triangular lobes each up to 0.6–0.8 cm long, calyx and pedicel brilliant coral-red or scarlet, glabrous, petals absent. The male flowers contain a staminal column about 0.5–0.9 cm long, the lower half nearly globular and 5-lobed, the upper half slender and bearing at its summit a globular mass of 15 yellow anthers. Female flowers consist of a glabrous ovary raised on a short gynophore, 0.2–0.4 cm long. Carpels 5, yellow, nearly or quite free with styles cohering when young but eventually separating, 0.3–0.4 cm long; stigmas small and rounded; bases of carpels surrounded by 15 staminodes clustered in 5 bundles. Flowers Nov.–Jan. (earlier in northern stands).

Fruits: Up to 5 follicles per flower; follicles boatshaped, 10–20 cm long; glabrous outside and stellate-hirsute inside. Follicle tapers at the base and extends into a point at the apex. Seeds are numerous, oval-shaped, bright yellow and packed in a single layer. Each seed is loosely enclosed by a crisp persistent exotesta, consisting of numerous bristles, which are an irritant to human skin. Mature Dec.–Apr.

Wood: Sapwood pale, susceptible to *Lyctus* attack; heartwood, white, soft, straight grained, coarse texture, large wood rays, wood is not durable and susceptible to blue-stain, density 175–620 kg m⁻³. Small quantities of wood have been cut for plywood and model making, long thin wood shavings may be useful for making straw hats. Used as a substitute for balsa wood with potential for making surfboards.

Climate: Altitudinal range: near sea level to 800 m; hottest/coldest month: 26–32°C/2–10°C; Frost incidence: low to moderate; Rainfall: 1300–2000 mm per year, summer max.

Distinctive features: Copious red flowers produced while in deciduous phase; leaves palmate.



Brachychiton acerifolius 1. Intermediate leaf 2. Flowering inflorescence 3. Male flower (S.E.M.) 4. Fruits 5. Female flower (S.E.M.) 6. Seedling with cotyledons 7. Adult leaves 8. Tree in flower [photograph courtesy of Australian Information Service] 9. Cotyledons 10. Tree, near Dorrigo, N.S.W. 11. Bark

Kurrajong

Brachychiton populneus (Schott et Endl.) R. Br.

Kurrajong is an attractive well-shaped tree 10–20 m in height and 0.5–1 m in diameter. Individual trees have short, stocky boles and dense rounded crowns consisting of bright green leaves, which contrast sharply with most of the associated species. Some trees are semi-deciduous in early summer. This species is often cultivated as an ornamental. There are two subspecies, the typical and subsp. *trilobus*.

Subsp. *populneus* extends from the south-coastal areas of New South Wales and the upper catchments of coastal rivers on the north coast of New South Wales, north to Fraser Island in Queensland. Its inland extent is in the upper reaches of the Snowy River area in Victoria, north along the Tablelands and Western Slopes of New South Wales and the Darling Downs in Queensland. Subsp. *trilobus* extends from the Western Plains of New South Wales from the Lachlan River and Lake Cargelligo north to central Queensland including Rockhampton near the coast, with northern outliers inland from Townsville and at Ravenshoe in north Queensland.

Kurrajong mainly occurs on sodic loams and deep red sandy loams but may occur on skeletal soils on rocky hilltops throughout its range.

This species occurs in woodlands, commonly in small pure stands or as single trees. Associates are numerous and include black cypress pine (*Callitris endlicheri*), white box (*Eucalyptus albens*) and yellow box (*E. melliodora*).

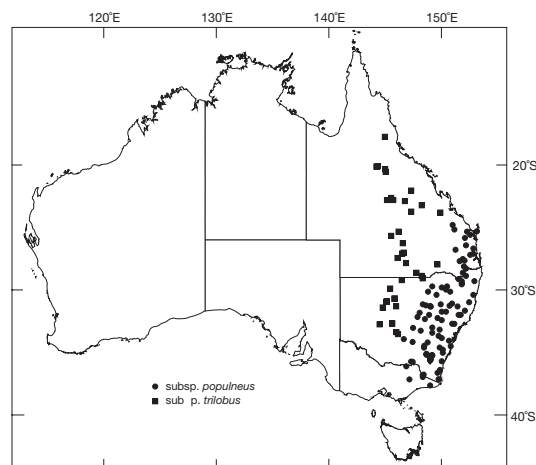
Related species: The closest relative of *B. populneus* is the desert kurrajong (*B. gregorii*), which differs in having glabrous or sparsely hairy outer perianth and in having mainly 20 stamens and staminodes. The genus *Brachychiton* was revised by Guymer (1988).

Names: Botanical—*Brachychiton*, from the Greek *brachys* (short), plus *chiton* (tunic), in allusion to the short bristles surrounding the seed in the fruit; *populneus*, from the Latin *populus* (poplar-like), alluding to the similarity of the adult leaves to leaves of the European poplar (*Populus* spp.). Common—of Aboriginal origin.

Publication: Subsp. *populneus*: *Plantae Javanicae Rariores* 234 (1844). Type: Australia (Sydney district, New South Wales), 1803–04?, F.L. Bauer. Subsp. *trilobus* Guymer: (1988) *Aust. Sys. Bot.* 1, 235. Type: Between Cooper's Bridge and Euagalong, north side of the Lachlan River, 10–13 miles [16–21 km] from Cooper's Bridge, Western Plains, New South Wales, Feb. 1964, Walker ANU 1306.

Bark: Grey, hard, with shallow vertical fissures, granular in texture and very tight on the tree trunk. Blaze of large trees pink with a purple-black network.

Leaves: Cotyledons—large, petiolate, elliptical, 2–3 × 2–2.5 cm. Seedling—wide variation in seedling sizes and shapes even in the same seedlot; generally alternately arranged. First pair deltoid, subsequent leaves becoming ovate then lanceolate and some even trifid, about 7–10 × 4–5 cm, discolorous, with 2 apiculate stipules 0.3 × 0.1 cm at base of



each petiole; stem and petioles covered in minute upright hairs; top of primary root noticeably enlarged and 2–3 times wider than stem diameter. Adult—alternate; long slender petioles to 1–3 cm long; leaves entire or shallowly 2–3-lobed (*populneus*) or deeply 3-lobed (*trilobus*), 6–7 × 2–3 cm, with long narrow leaf tips, often with 3 but rarely up to 5-lobed leaves, glossy green, discolorous. Used for stock fodder during drought.

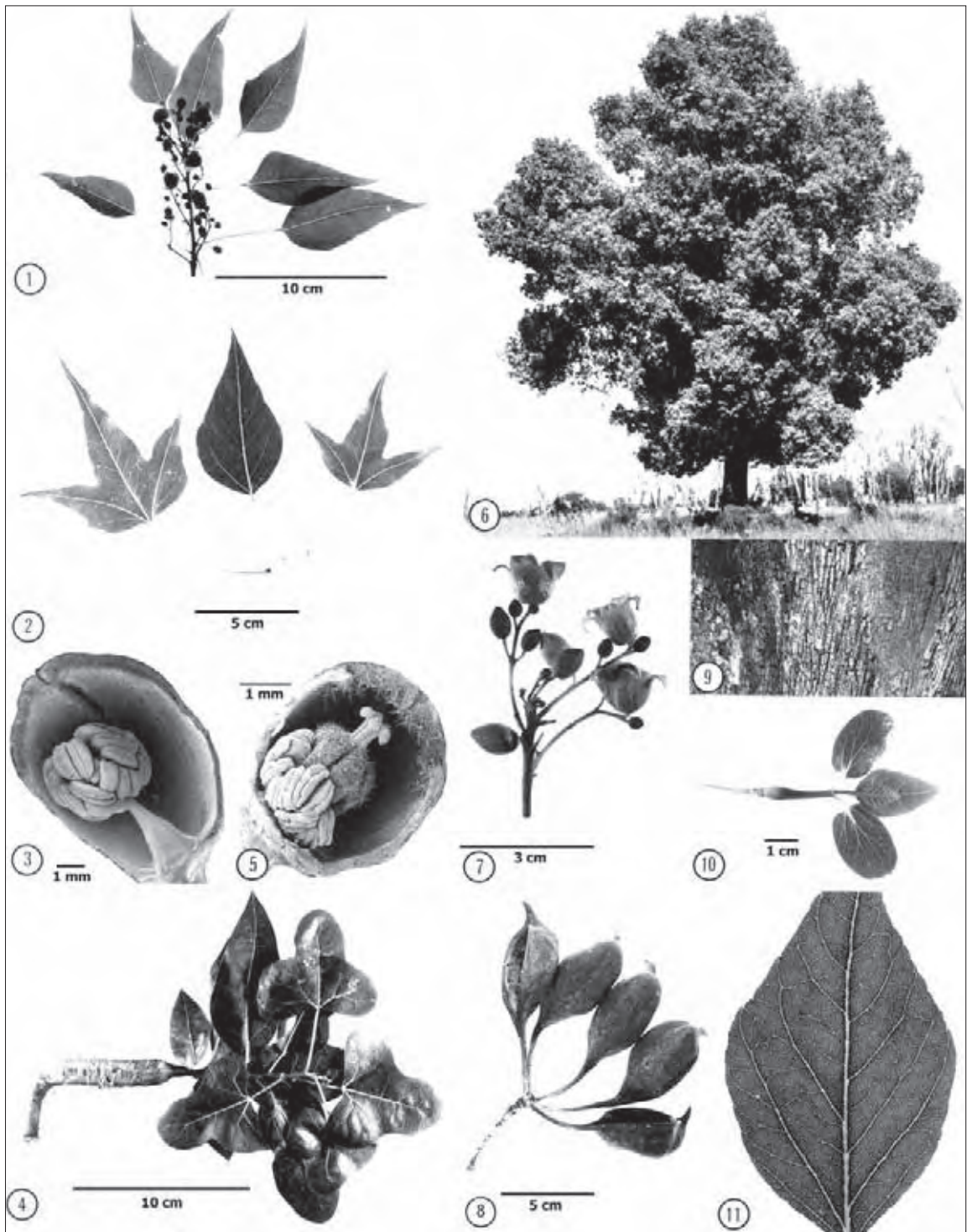
Inflorescences: Axillary panicles, which rarely protrude beyond the margins of the crown. Floral buds sparsely pubescent. Flowers unisexual, campanulate, 1–1.2 × 1.3–1.6 cm. Calyx petaloid, united, tubular and 5-lobed, cream to greenish with throats flecked with red, petals absent. Male flowers have a staminal tube with (18)20 anthers clustered around the top; female flowers have 5 free carpels with only the upper parts of the styles connate. Carpels are covered in white hairs, surmounted on a short grey gynophore to which is attached 5 bundles of 3–4 sessile (or almost so) staminodes. Flowers Oct.–Mar.

Fruits: Follicles, usually 5 per flower (fewer through abortion), woody, boat-shaped, 4–7 cm long on stipes 2–3.5 cm long (*populneus*) or 2–4 cm long on stipes 2–5 cm long (*trilobus*), beaked (to 1 cm long). Fruit opens in a long slit along one side to reveal 6–22 seeds (*populneus*) or 3–11 seeds (*trilobus*) embedded in a hairy mass of prickly fibres. Mature Dec.–Jun.

Wood: A light, soft, creamy-hued timber of open texture; interweaving definite ray-grain giving a silken sheen; poor strength and low durability; density 450 kg m⁻³. The wood is rarely utilised nowadays but has been used in the past for lattice construction and as a softwood for interior furnishings.

Climate: Altitudinal range: 50–1000 m (*populneus*), near sea level to 450 m (NSW) and 700 m (Qld) (*trilobus*); hottest/coldest months: 25–31°C/–1–4°C (*populneus*) 32–35°C/3–8°C (*trilobus*); Frost incidence: low to moderate (up to 40 frosts per year at some sites); Rainfall: 450–1000 mm per year (*populneus*), 350–600 (–1200) mm per year (*trilobus*), summer max. in the north, uniform in the south.

Distinctive features: Boat-shaped follicles, and the occasional presence of 3 or 5-lobed leaves among the otherwise entire adult leaves.



Brachychiton populneus 1. Adult leaves and flowers 2. Juvenile leaves indicating various leaf shapes 3. Male flower (S.E.M.) 4. Seedling indicating enlarged root stock 5. Female flower (S.E.M.) 6. Tree, between Tottenham and Tullamore, N.S.W. 7. Buds and flowers in inflorescence 8. Fruits 9. Bark 10. Young seedling with pair of cotyledons 11. Adult leaf venation

White Beech

Gmelina leichhardtii (F. Muell.) F. Muell. ex Benth.

White beech is a tall tree usually up to about 30 m in height and 2 m in diameter but a tree at Terania Creek, New South Wales, measured 59 m in height and 2.65 m in girth. Tree boles are moderately buttressed or flanged at their bases, and the stems above the buttresses are often irregular or fluted. The crown is somewhat open with large, more or less horizontally disposed leaves. This is a semi-deciduous tree during November.

This species occurs from the Clyde River area, New South Wales, to the Blackall Range, Fraser Island and the Maleny district of southern Queensland. Farther north, disjunct populations occur on the Eungella Range west of Mackay and on Mt Elliot, south of Townsville.

White beech grows on a wide range of sites from near creek banks to the sides of mountains. Deep alluvial soils are preferred but it also grows on soils derived from basalt. Grows on sandhills on Fraser Island and Caloola, Queensland.

This species occurs commonly in subtropical rainforests often with *Flindersia* spp., yellow carabeen (*Sloanea woollsii*), red carabeen (*Geissois benthamiana*), kauri (*Agathis robusta*), sassafras (*Doryphora sassafras*) and blush and brown tulip oaks (*Argyrodendron* spp.).

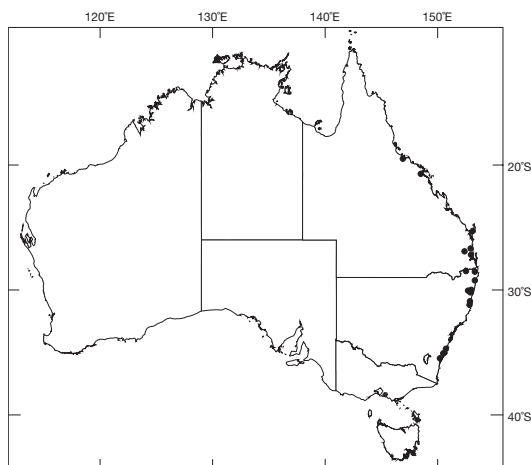
Related species: Three species of *Gmelina* occur in Australia: *G. fasciculiflora*, which is endemic and occurs in the Cairns–Atherton area, Queensland, *G. dalrympleana*, which occurs in northern Australia and Papua New Guinea, and *G. schlechteri* in Northern Territory and New Guinea. *G. fasciculiflora* is distinguished by its flowers which are in sessile cymes forming the panicles. *G. dalrympleana* has large leaves, up to 25 cm long, and fleshy reddish-pink fruits.

Publication: *Fl. Austral.* 5, 66 (1870). Type: syntypes collected at Myall Creek, Queensland, by L. Leichhardt and Clarence River, New South Wales, by H. Beckler.

Names: Botanical—*Gmelina*, honours J.G. Gmelin (1709–1755), a German explorer and traveller; *leichhardtii*, honours F.W. Ludwig Leichhardt (1813–1848), a German-born explorer of eastern Australia. Common—alludes to the timber being similar to that of European beech (*Fagus* spp.).

Bark: Grey or dark grey and scaly, the scales generally angular but occasionally rounded. The cut blaze is flesh-coloured near the sapwood. Young trees have raised corky pustules.

Leaves: Cotyledons—opposite; petioles short, 0.1 cm long and strap-like in appearance; elliptical, emarginate, about 1 × 0.9 cm fleshy, slightly hairy. Seedling—opposite; petioles to 0.3–0.4 cm long; broadly lanceolate, leaf of first pair about 5 × 2 cm, serrate (4–6 serrations on each side of the leaf), dark green above, discolourous; venation raised and prominent on the undersurface; hypocotyl, epicotyl, stem petioles and leaves covered in clear-coloured hairs, shorter ones apiculate, longer ones terminating in a ball-like structure. Adult—opposite; petioles thick, 3–4 cm long; rather coarse, ovate to broadly ovate to heart-shaped, obtuse, 10–15 × 7–10 cm, upper surface glabrous but undersurface, petioles, young shoots and smaller branchlets covered with a dense velvety down. The venation is raised and conspicuous forming a reticulum.



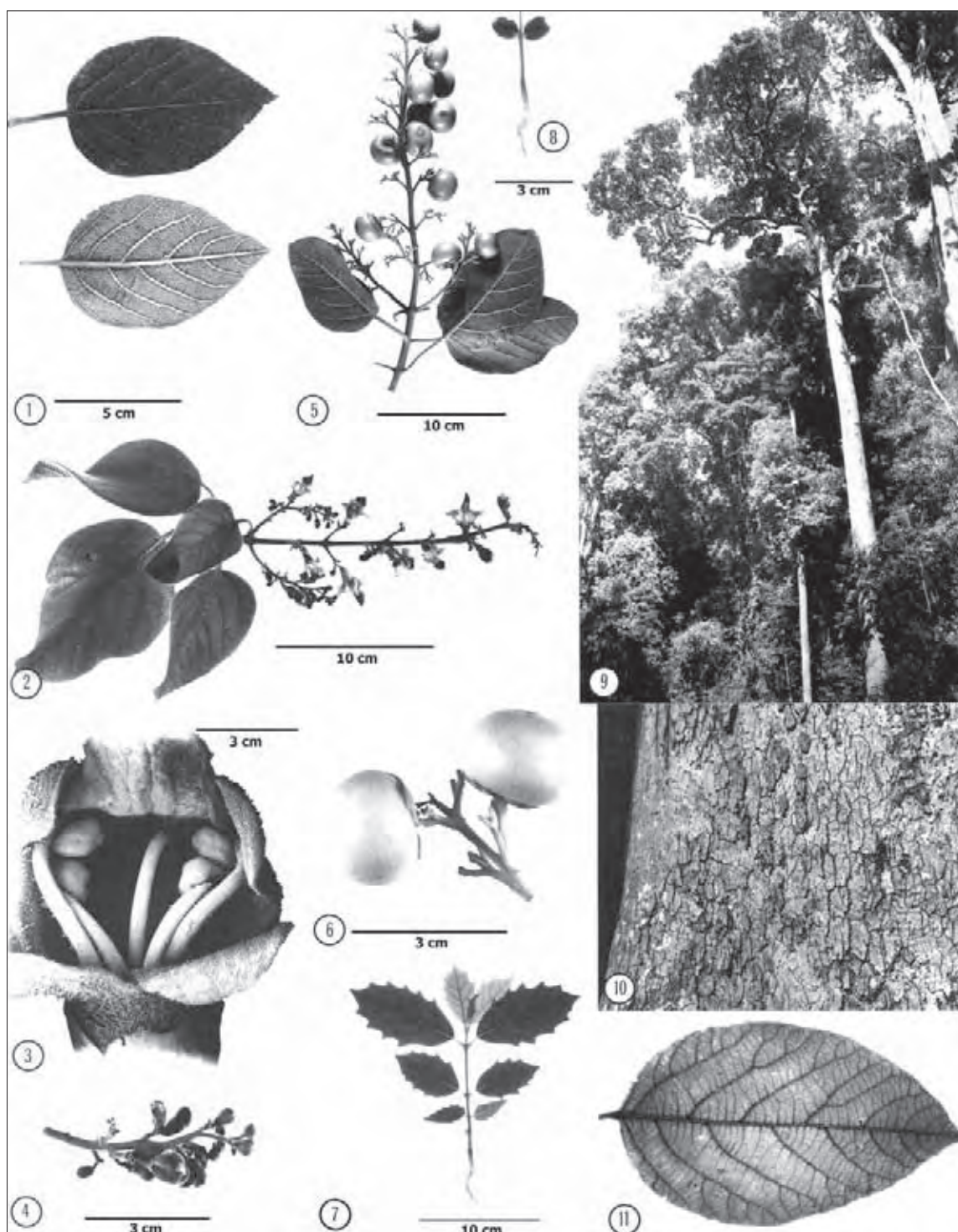
Inflorescences: Large terminal panicles about 15–20 cm long consisting of many flowers. Flowers large, about 2.5 × 2 cm, slightly asymmetrical. Calyx green, campanulate, united, tips lobed, about 0.5 × 0.4 cm. Lower part of the petals united and with 5 deeply-lobed upper parts, approximately triangular, about 0.5 × 0.5–0.7 × 0.7 cm. Corolla densely covered on the outside with darkish hairs. Flowers mostly white, the free part of the main petal being purple with 2 bar-like, central yellow markings. The adjacent throat is lightly streaked with purple and has some yellow patches near the bases of adjacent stamens. Four incurved slender stamens, 2 slightly larger than the other pair and about 1–1.5 cm long, anthers horseshoe-shaped. Long hairs occur between the bases of the filaments on the corolla. Flowers Nov.–Jan.

Fruits: Succulent, rounded but somewhat flattened at each end, 2–3 × 2.5–3.5 cm, blue or purplish when mature. Each fruit when shed has a large flattened persistent calyx about 2 cm diameter at its base, which is closely appressed to the fruit. Inside the fleshy mesocarp is a hard ‘stone’, about 1.5 × 2.0 cm, which is divided into cavities and in the uppermost part of which are 4 cells, each cell containing a single oval seed about 1 cm long. Mature Mar.–Apr.

Wood: Sapwood indistinct from the heartwood, attacked by *Lyctus*; heartwood light grey-brown, durability and resistance to termites not known, but is reputedly durable and termite resistant, grain somewhat interlocked, soft, density 420–660 kg m⁻³ and exhibits low shrinkage. The timber is easy to work, somewhat oily and hence has poor gluing properties, tends to rust nails, and is slow to dry. The wood is very valuable and in the past was much in demand for templates, pattern making, carving and turnery, indoor joinery, flooring, cabinet and carriage work, outdoor furniture and planking for boat hulls.

Climate: Altitudinal range: near sea level to 500 m; hottest/coldest months: 26–30/5–10°C; Frost incidence: low; Rainfall: 1000–2000 mm per year, summer max.

Distinctive features: Large semi-deciduous tree with grey scaly bark, large rather coarse leaves with reticulate venation, large purplish fruits and irregularly shaped flowers.



Gmelina leichhardtii 1. Adult leaves, upper and lower surface 2. Adult leaves and inflorescence 3. Flower (S.E.M.) 4. Floral buds 5. Fruiting branch 6. Fruits 7. Seedling 8. Cotyledons 9. Tree, Wiangaree State Forest, near Kyogle, N.S.W. 10. Bark 11. Adult leaf venation



ANGIOSPERMS—MONOCOTYLEDONS



Palms

Palms are often conspicuous in the wetter forests of northern and eastern Australia, but there are no species native to the south-western part of the continent or Tasmania and only one species in Victoria. In the higher rainfall areas they usually have discontinuous patterns of distribution, most species being confined to drainage lines, swamps or areas where the watertable is close to the surface for a considerable part of the year. They may be found on more rugged, drier slopes, as late colonisers in the vegetation, but they are seldom pioneers as their growth rates are usually too slow and seedlings of many genera are intolerant of open sunny conditions. In north-western Australia, however, and particularly in the Kimberley region, species of *Livistona* occur widely on seasonally dry to very dry sites.

In Australia the greatest concentration of palm species is in north-eastern Queensland. In the region between Tully and Mossman there are 22 species, representing 11 genera. Most species are restricted to within 80 km of the coast, but species of *Livistona* occur near Mataranka in the Northern Territory, and in the MacDonnell Ranges of central Australia, the Carnarvon Gorge in central Queensland and the Fortescue River in mid-northern Western Australia. *Corypha* colonises drier areas in riparian open forest in northern Queensland, but seldom extends farther inland than 120 km.

The altitudinal range of palms in Australia is from sea level to 1500 m on the Bartle Frere Ranges, about 17°20'S where *Laccospadix* and *Linospadix* occur. At 33°30'S (at Bilpin, in the Blue Mountains west of Sydney), *Livistona australis* occurs at about 550 m, while at its most southerly occurrence, near Orbost, Victoria, at 37°44'S, this species is limited to about 20 m above sea level.

Palms occur in a wide range of forest types, from mangroves and swamp forest, through rainforest to open rainforest and woodlands; most species are associated with rainforest or swamp forest communities or the mixed forests, which are marginal to these, but *Livistona*, *Gronophyllum* and *Corypha* are more characteristic of open forest communities and *Nypa* is a mangrove palm.

Soil types are fairly closely correlated to forest types and range from undeveloped dune sands to seasonally or permanently wet soils. Deep cracking clays do not usually support palms. *Calamus* successfully colonises deep basalt soils, it is a late coloniser, requiring moderate to heavy canopies, implying some protection from exposure for establishment.

Morphology

Palms are monocotyledons, lacking cambium layers and so not producing the secondary wood or bark of dicotyledons. Stems may thicken by expansion of parenchyma cells and in a few cases by the formation of strands of fibrous tissue. The stem surface is smooth or fibrous, with scars or indentations, which may form complete rings around the stem marking the former attachment of leaf bases, or the sheathing leaf base is persistent on the stem.

Palm stems have a single growing point, only a few genera developing branches. The stems may creep underground, be prostrate, erect or climbing, clumped, colonial or solitary. Some species produce both single and clumped stems, often related to differences in habitat. Most Australian genera have erect stems, although *Calamus* has climbing stems and *Nypa* has rhizomes on or just beneath the soil surface, with large erect leaves rising like a giant rosette to 12 m tall. Some tall

single-stemmed species also have a conspicuous rosette form in their young stages before the development of a stem (e.g. *Licuala*, *Livistona*, *Orania*).

Leaves are spirally arranged in several ranks and are typically bunched, appearing as a rosette or crown at the top of a pole. In some genera, such as *Calamus*, the internodes are quite long, so that the leaves are spread along the stem. Leaves are palmate or costapalmate (fan-like), pinnate (feathery) or bipinnate, or have simple entire or lobed blades. In Australia entire leaves occur only in the seedling leaves and occasionally in adult forms of *Linospadix* species. *Normanbya* leaf segments undergo a secondary division, which could be regarded as a parallel type of bipinnation; a similar but more complex pattern occurs in an undescribed genus in northern Queensland. Leaflets tend to have parallel sides with variously shaped tips characteristic of different genera.

Petioles are absent in some species of *Calamus* and *Linospadix* but present in other genera; they may be smooth or armed with spines.

The base of each leaf is laterally expanded into a closed sheath surrounding the stem and often the younger plant parts. Inflorescences are commonly developed in the axils of leaf bases, and emerge among the green leaves of the crown. In other genera the development of the inflorescence is delayed until the subtending leaf is shed, so that it appears below the crown.

Inflorescences may be simple or compound, often large with many small flowers, which are unisexual in many genera. Initially the inflorescence is enveloped in one or more large tubular bracts. The flowers may be insect or wind-pollinated and generally consist of a small 3-segmented calyx, 3-segmented corolla, 3–6 or many stamens (or staminodes) and 3 free or united carpels.

The fruit is usually 1-seeded, sometimes 2 or 3-seeded, rarely up to 12-seeded. Surrounding the seeds is a pericarp consisting of 3 layers; the inner layer, the endocarp, may be hard and woody; the middle layer, the mesocarp, is fleshy or fibrous and the outer layer or skin, the exocarp, is usually thin and weak.

Australian Palm Groups

The Australian palms fit into 5 of the 15 groups used by Moore (1973) namely Coryphoid, Leptocaryoid, Nypoid, Caryotoid and Arecoid palms. These groups have been regarded as sub-families by other authors.

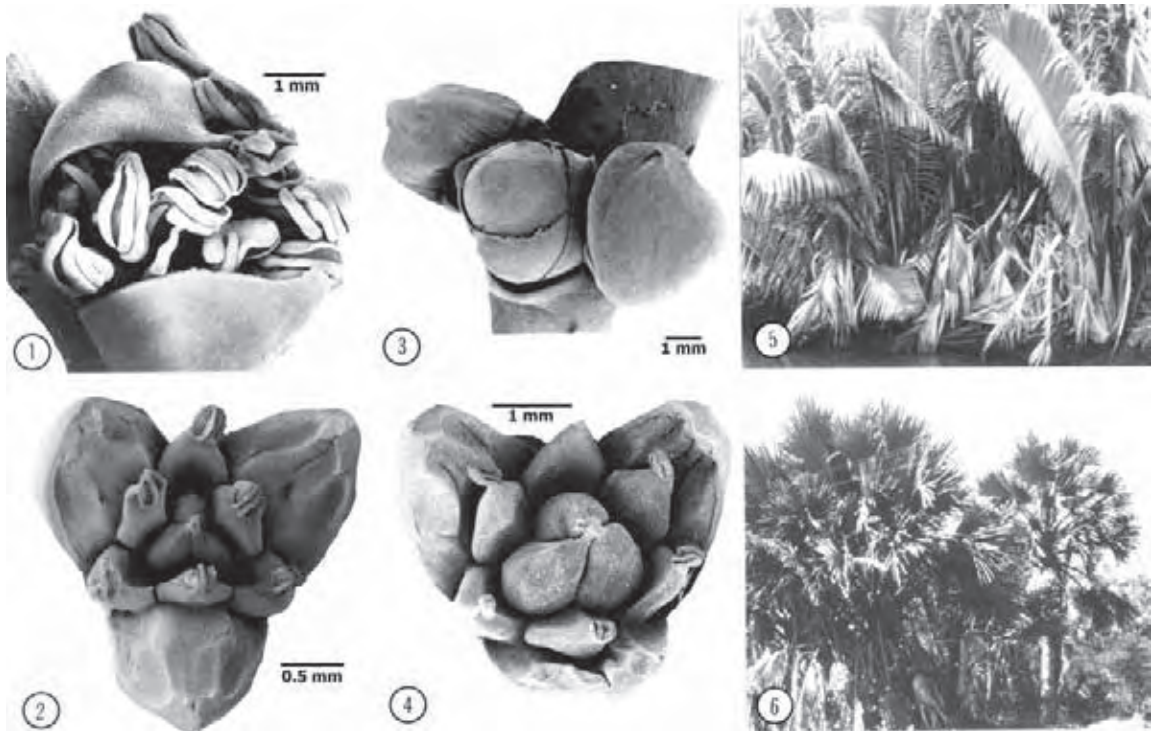
Coryphoid palms have fan-shaped leaves, with segments induplicate (V-shaped) at the point of attachment. In *Livistona* the segments taper towards the top and the inflorescences are borne in the axils of new leaves. *Licuala* also bears its inflorescences in the leaf axils, but the leaves are circular in outline, with several-veined segments that terminate abruptly in 2–6 teeth. *Corypha* is unique among the Australian palms in producing a terminal inflorescence, and dying after flowering.

Leptocaryoid palms are climbers armed with spines on the leaf sheath and rhachis, with pinnate leaves and long whip-like flagella armed with hooked spines. The Leptocaryoid palms have fruits that are covered by small overlapping scales, borne on lateral inflorescences in *Calamus*, the only Australian genus in this group.

The Nypoid group consists of a single species, *Nypa fruticans*, which bears its female flowers in a terminal head, developing into a globose compound fruit.

Caryotoid palms are represented in Australia by two genera, *Caryota* and *Arenga*. They have pinnate leaves whose segments are induplicate (V-shaped) and produce their inflorescences in the leaf axils, from the tip downwards; when the lowest inflorescence fruits the stem dies. *Caryota* has narrowly fan-shaped leaf segments, while *Arenga*, usually multi-stemmed, has leaf segments which are notched along the edges, terminating in several teeth and pale on the undersurface.

Arecoid palms have pinnate leaves with the segments reduplicate (A-shaped) at their insertion on the rhachis. This is the largest subfamily of palms, with nine genera represented in Australia. *Orania* has long leaves with numerous pinnae, silvery or rusty beneath and with truncate or jagged ends. Its inflorescences are produced in the leaf axils, flowers have 3-celled ovaries with 3 ovules, and fruits are bright yellow



Palms: *Livistona australis* (La), *Archontophoenix cunninghamiana* (Ac), *Nypha fruticans* (Nf), *Corypha elata* (Ce) 1. Male flower (La) (S.E.M.) 2. Male flower (Ac) (S.E.M.) 3. Female in centre flanked by two male flowers (La) (S.E.M.) 4. Female flower (Ac) (S.E.M.) 5. Stand (Nf), Halifax area, near Ingham, Qld [photograph by A. Irvine] 6. Stand (Ce), near Laura, northern Qld [photograph by A. Irvine]

in the Queensland species, *O. appendiculata*. *Archontophoenix* is an Australian genus with ringed stems, long glossy crownshaft and pointed pinnae. *Linospadix* consists of dwarf slender-stemmed palms with unbranched inflorescences. *Laccospadix* is closely related to *Linospadix*, with slender smooth green stems and glossy red fruits on long spikes. *Normanbya normanbyi* is endemic to Queensland. It has pinnate leaves with broad, many-ribbed segments, jagged at the ends, arising in clusters at many angles from the rhachis and whitish beneath. *Ptychosperma* has leaflets with jagged ends and red fruits with five-furrowed seeds. *Carpentaria* and *Gronophyllum* occur in the Northern Territory, *Carpentaria acuminata* with a slender stem, glossy dark green leaves and spherical orange-red fruits while *Gronophyllum ramsayi* with a slightly swollen stem, pale green leaves and crownshaft, and shiny

red elliptical fruits. *Hydriastele* forms clusters of stems, each with a white crownshaft, and leaf segments irregularly spaced on the rhachis, the terminal pair fused at the base. The closely related *Galubia* has single stems with a green crownshaft and the terminal pair of leaflets are scarcely joined. Leaves are pale beneath and end in a long fine flagellum.

Commercial Use

Commercial use of palms has been rather limited in Australia, the very small plantations being based on the introduced coconut, oil and date palms. The only use of Australian palms has been for rattan furniture, from the lawyer canes (*Calamus* species). There is potential for production of alcohol from *Nypa* and of wax from species of *Livistona*, but neither of these uses has been seriously considered.

Cabbage-tree Palm Cabbage Fan Palm, Daranggarra

Livistona australis (R. Br.) Mart.

Cabbage-tree palm is a tall palm up to 25 m in height with a slender stem of about 0.25–0.35 m diameter. The crown is spherical to slightly elongated in shape and dense, consisting of dark green living leaves. The dead lower leaves in the crown can persist for some time before they are shed.

This species occurs sporadically from near Orbost, Victoria, to Fraser Island off the Queensland coast, and the Mary River areas. There are widely disjunct occurrences of cabbage-tree palm on the Eungella and Paluma Ranges at high altitudes in central subcoastal Queensland.

The species occurs on moist or seasonally wet sites. In the southern part of its range it is restricted to creek banks and alluvial flats occasionally spreading to adjacent slopes. Along the central coast of New South Wales from about Nowra to Kempsey it was evidently more widespread in the past, as shown by relic trees left on cleared land, occurring on flat land close to the coast, but as far inland as Bilpin on the eastern foothills of the Blue Mountains in sheltered gullies. Farther north it occurs on moist, seasonally flooded sites close to the coast; much of this land has been cleared for sugar cane or dairy farming but Stotts Island in the Tweed River is typical. The species also prefers lower, alluvial, estuarine sites and commonly occurs on filled-in coastal lagoons.

Many of the soils are sandy loams with high organic matter in the surface layers but this species also occurs on well-structured clay loams, brown earths and brown podsols, derived from alluvial material, sandstones, shales or, occasionally, tuffs.

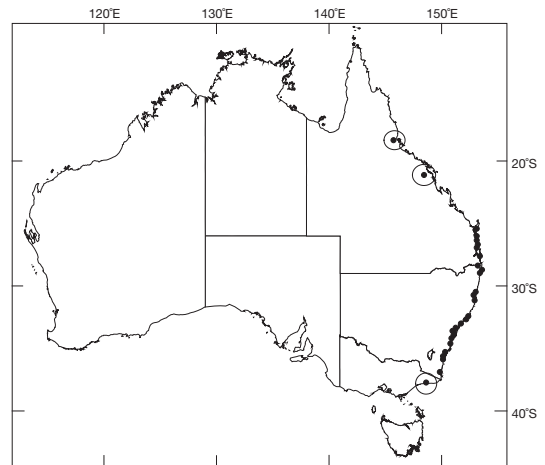
Cabbage-tree palm occurs in temperate and littoral rainforests, moist open forests and in swamp forests. Associated species include lilly pilly (*Acmena smithii*), bangalay (*Eucalyptus botryoides*), swamp oak (*Casuarina glauca*) and five-veined paper bark (*Melaleuca quinquenervia*).

Cabbage-tree palm is moderately fire-resistant. The dead leaves lying about the base of the stem are highly combustible, and the surface of the stem is often blackened and occasionally carries charred leaf-stumps.

Related species: There are about 30 species of *Livistona* with 16 species occurring in Australia (Rodd 1998). They include the ubiquitous small sand palm (*L. humilis*) of the Northern Territory and the renowned Palm Valley palm (*L. mariae*), of the MacDonnell Ranges in central Australia. *Livistona australis* is replaced by *L. decipiens* to the north of its main distribution. Livistonas include the most drought-tolerant of Australian palms.

Publication: *Hist. Nat. Palm.* 3, 241 (1839). Type: Port Jackson, New South Wales, R. Brown.

Names: Botanical—*Livistona*, honours Baron Livistone, founder of the Botanic Garden, Edinburgh, Scotland; *australis*, from the Latin *australis* (southern). Common—refers to the edible cabbage-like growth at the apex of the stem.



Stems: Grey-brown, rough and finely fibrous, with incomplete rings marking the lines of attachment of the leaves.

Leaves: Seedling—clasping the stem, first leaf narrow-lanceolate to linear, 10–25 × 1–1.5 cm, with several prominent longitudinal veins; next 5–7 leaves linear oblong, simple, petioles thick, flat above, rounded beneath, 4–16 cm long, enclosing the stem with a brownish fibre, later breaking away to leave a lacy network of thin fibres, upper edges of petiole with sharp spines which extend up the margin of the leaf blade for some distance, the main prominent veins of the leaf blade clothed in a white fibrous tissue; later leaves divided and spread to become palmate with slender petioles. Adult—broadly fan-shaped to circular in outline, costapalmate (with a short midrib visible on the back of the leaf), the blade initially folded into numerous narrow, one-veined plications, which separate into V-section segments in the outer half; the undivided part of the leaf is relatively rigid, with the outer part of the segment pendant; the leaves are glossy dark green and are about 1 m across, borne on petioles up to 2 m long, with short bases which do not completely sheath the stem; short, recurved spines occur along the margins of the petiole for the lower third of its length.

Inflorescences: Paniculate, up to 1.5 m long. Flowers sessile, cream, bisexual. Sepals 3, obtuse. Petals 3, acute, about 0.3 cm long. Stamens 6, with short broad filaments. Carpels 3, each with a short blunt stigma. Inflorescences produced in spring within the crown, initially enclosed in several bracts.

Fruits: Black, globular, about 2 cm in diameter with a granular pericarp enclosing a single seed surrounded by a fleshy layer.

Wood: No details available.

Climate: Altitudinal range: near sea level to 100 m; hottest/coldest month: 25–30°C/4–8°C; Frost incidence: low (virtually frost free); Rainfall: 800–1400 mm per year, uniform to summer max.

Distinctive features: *Livistona australis* is the only fan palm native to New South Wales and Victoria. A tall, slender palm with a globular crown of dark green, costapalmate leaves. Fruits are globular, black.

Bangalow Palm Picabeen Palm

Archontophoenix cunninghamiana H. Wendl. & Drude

Bangalow palm is a tall, slender palm up to 20 m tall and 0.3 m in diameter. It is graceful in appearance with a distinctive umbrella-shaped crown of long, curved, dark green, pinnate leaves. The new unexpanded leaves form a short spire above the canopy.

Bangalow palm occurs on the east coast of Australia from just north of Batemans Bay, New South Wales, to near Bundaberg, Queensland. Two isolated stands of this or a related species occur farther north near Yeppoon and on the Eungella Ranges, near Mackay. It is common locally in patches close to the coast but extends inland near the Queensland–New South Wales border and to the eastern edge of the Gibraltar Range west of Grafton, New South Wales.

Generally bangalow palm occurs on warm moist, low-lying sites, in gullies or along creek lines. It is found on poorly differentiated alluvial soils, podsollic to volcanic soils, ranging in texture from loamy sands to clays.

Bangalow palm occurs mainly in small patches or as a subsidiary species in subtropical rainforest (simple notophyll vine forest) or wet sclerophyll forest (tall open forest). It appears to favour slightly wetter sites than the cabbage-tree palm (*Livistona australis*).

Related species: *Archontophoenix* is an endemic Australian palm genus, which occurs on the eastern coast, between Cape York and Batemans Bay. Dowe and Hodel (1994) revised the genus and recognised four new species (*A. maxima*, *A. myolensis*, *A. purpurea* and *A. tuckeri*) raising the number of species in the genus to six. Alexandra palm (*A. alexandrae*), a commonly cultivated species, is native to the Queensland coast north of Bundaberg. It has leaves with a paler, pruinose undersurface.

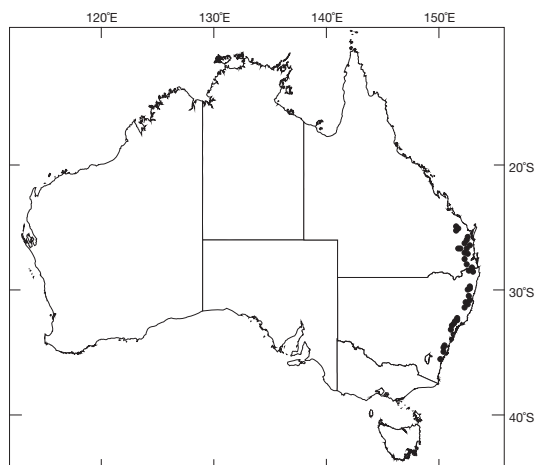
Publication: *Linnaea* 39, 214 (1875). Type: *Hook. Bot. Mag.* 83, t.4961, Figs. 1–6 (1857).

Names: Botanical—*Archontophoenix*, from the Greek *archon* (a chieftain), plus *phoenix* (the date palm); *cunninghamiana*, honours A. Cunningham (1791–1839), an explorer and botanical collector mainly in eastern Australia. Common—*bangalow* and *picabeen* are names of Aboriginal origin.

Stems: Smooth grey or green trunks marked by rings where the leaf-bases have been shed. The outer ‘bark’ is very thin.

Leaves: Seedling—alternate, petioles scurfy, 2–6 cm long, sheathing base embracing the stem, divided into 2 lanceolate lobes 7–16 cm long, venation penninerved with 5–7 prominent parallel veins; later seedling leaves similar but up to 45 cm long including petiole. Adult—pinnate, about 4 m long with a conspicuous cylindrical sheathing base about 60 cm long and numerous leaflets, 60–100 × 5–7 cm, elongated with a long, acute tip, dark glossy green on both surfaces.

Inflorescences: Appear beneath the leaf bases and are at first protected by 2 bracts about 60 cm long. Male and female flowers are borne on numerous long slender branches, and are stalkless with 3 sepals and 3 petals. Flowers are in triads consisting of 2 outer male flowers and an inner female flower



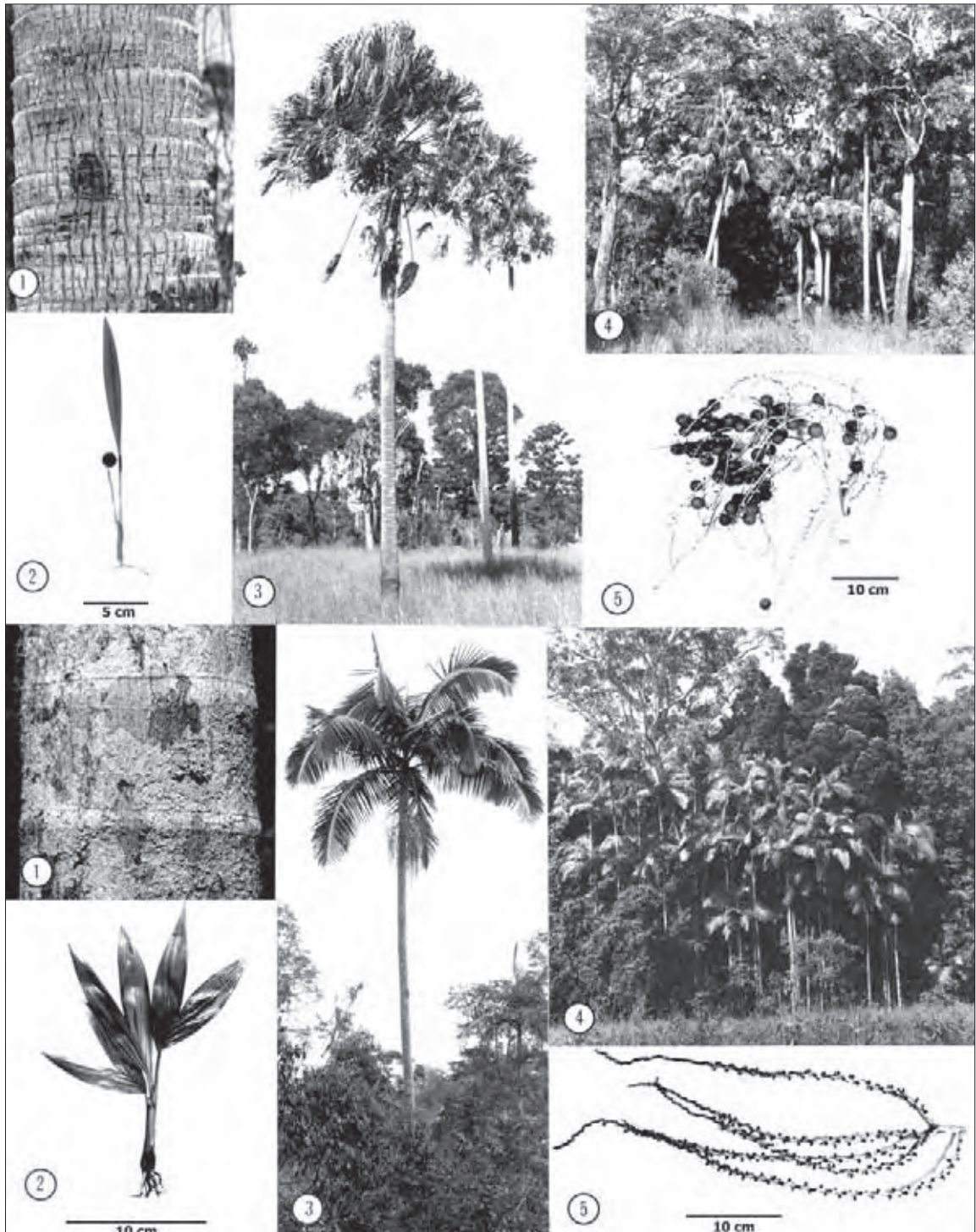
which opens only partially and at a later time than the outer 2 male flowers. Male flowers have 9–18 stamens, free from the corolla but forming a disc at the base. Female flowers have a single ovary with 3 small stigmas. Flowers have a purplish tint and appear all year with increased intensity between Jun.–Jan.

Fruits: Globular or ovoid, orange-red, about 1 cm long, fleshy with a smooth surface crowned by the remains of the stigmas. Seeds are elliptical and smooth, but usually covered by persistent flattened sinuous inner mesocarp fibres after the remainder of the fruit has decayed. The endosperm in the seed is intruded by many small bars of seedcoat tissue (ruminate endosperm). Mature mainly during Dec.–Mar. (but some present all year).

Wood: Composed of a pithy matrix of parenchymatous tissue with a brown-sugar hue and lustre when dry, cross-section of trunk is closely spotted with round vascular bundles, i.e. bundles of fibres and vessels, which are brown and very hard to cut, fissile, centre of trunk is very soft and pithy with outer 4–6 cm of wood being hard; very dense, density about 1000 kg m⁻³. The wood is used for making small ornamental articles and for inlay work. It is suitable for walking sticks, umbrella handles and batons.

Climate: Altitudinal range: near sea level to 1200 m; hottest/coldest month: 27–32°C/4–10°C; Frost incidence: low; Rainfall: 1000–1550 mm per year, mainly summer max.

Distinctive features: A tall slender palm with feathery green leaves, smooth trunk, purplish flowers and orange-red fruits.



Livistona australis [top] 1. Stem 2. Seedling 3. Palm, near Ulong, N.S.W. 4. Stand, near Iluka, N.S.W. 5. Fruiting inflorescence

Archontophoenix cunninghamiana [bottom] 1. Stem 2. Seedling 3. Tree, near Bulahdelah, N.S.W. 4. Stand, near Bulahdelah, N.S.W. 5. Inflorescence

Carpentaria Palm

Carpentaria acuminata (Wendl. & Drude) Becc.

Carpentaria palm grows as a tall, slender, single-stemmed palm to 30 m in height but only 0.25–0.3 m in diameter and with a small crown spread of about 5 m. The leaves are shed, apparently after three seasons, to leave a clean stem. It is a most conspicuous palm in the small patches of vine forest, which occur along spring-fed permanent streams near Darwin and is probably the most common palm found in Darwin gardens.

This palm occurs in coastal and subcoastal Northern Territory from the Darwin region south to the Fitzmaurice River region, the Tiwi Islands (Bathurst and Melville Islands), Coburg Peninsula with eastern outliers in Arnhem Land and the Wessel Island group.

This palm grows mainly on alluvial soils, generally loamy sands with high organic matter in the surface layers but often with leached clay at shallow depths. The sites are commonly flooded during the wet season and may remain saturated during most of the dry season.

Carpentaria palm occurs in small groups or as single trees, usually reaching the upper canopy of the monsoon or gallery forests (simple evergreen or semi-deciduous vine forests) in which it grows. It appears to be able to regenerate satisfactorily in medium-sized light breaks and to grow relatively quickly. Associated species include cheesewood (*Nauclea orientalis*), brown cudgerie (*Canarium australianum*), *Terminalia* species and a fan palm (*Livistona bentharii*).

Related species: There is only one species of *Carpentaria*; it belongs to the Arecoid group of palms, which is strongly represented in South-East Asia and tropical America, and includes *Archontophoenix* and *Ptychosperma*.

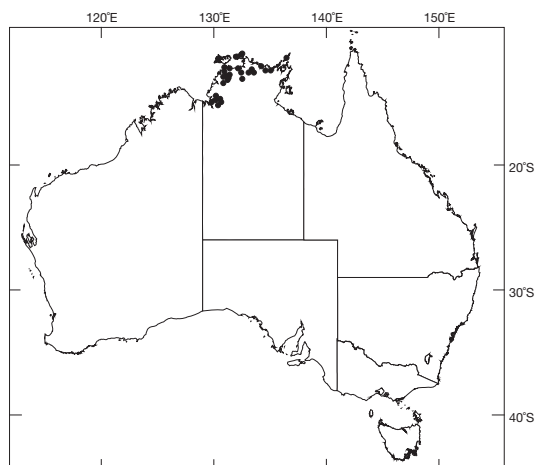
Publication: *Ann. Jard. Bot. Buitenzorg* 2, 128 (1885). Type: “Australasiae ora septentrionalis ad sinum Carpentaria in terra Arnhemica, loco ‘Escape Cliffs’ dicto! (leg. C. Hulls)”.

Names: Botanical—*Carpentaria*, origin not certain, but probably after the Gulf of Carpentaria; *acuminata*, from the Latin *acuminatus* (acuminate or tapering sharply to a point), alluding to the leaf tips. Common—as for the generic name.

Stems: Smooth grey trunks showing the rings of fallen leaves and often coloured by lichens.

Leaves: Seedling—two elliptical or narrowly lanceolate lobes, one on each side of a short midrib, each lobe 10–30 × 1–10 cm with 4–10 parallel veins; petioles slender, 10–60 cm long with a short sheathing base. Adult—about 3 m long with a smooth, stem-sheathing base about 60 cm long; each leaf has a short petiole and a slender arching midrib which carries the narrow strap-like leaflets, each folded back from its central vein, giving an inverted V section, with glossy dark green surfaces.

Inflorescences: Produced throughout the year from the stem below the leaves, at first covered by bracts about 40 cm long. Inflorescences compound with numerous slender branches bearing triads of one male and two female flowers, which are sessile, cream, with 3 sepals and 3 petals. Male flowers have about 30 stamens, with narrow anthers opening in longitudinal slits; also there is a central pistillode with a long



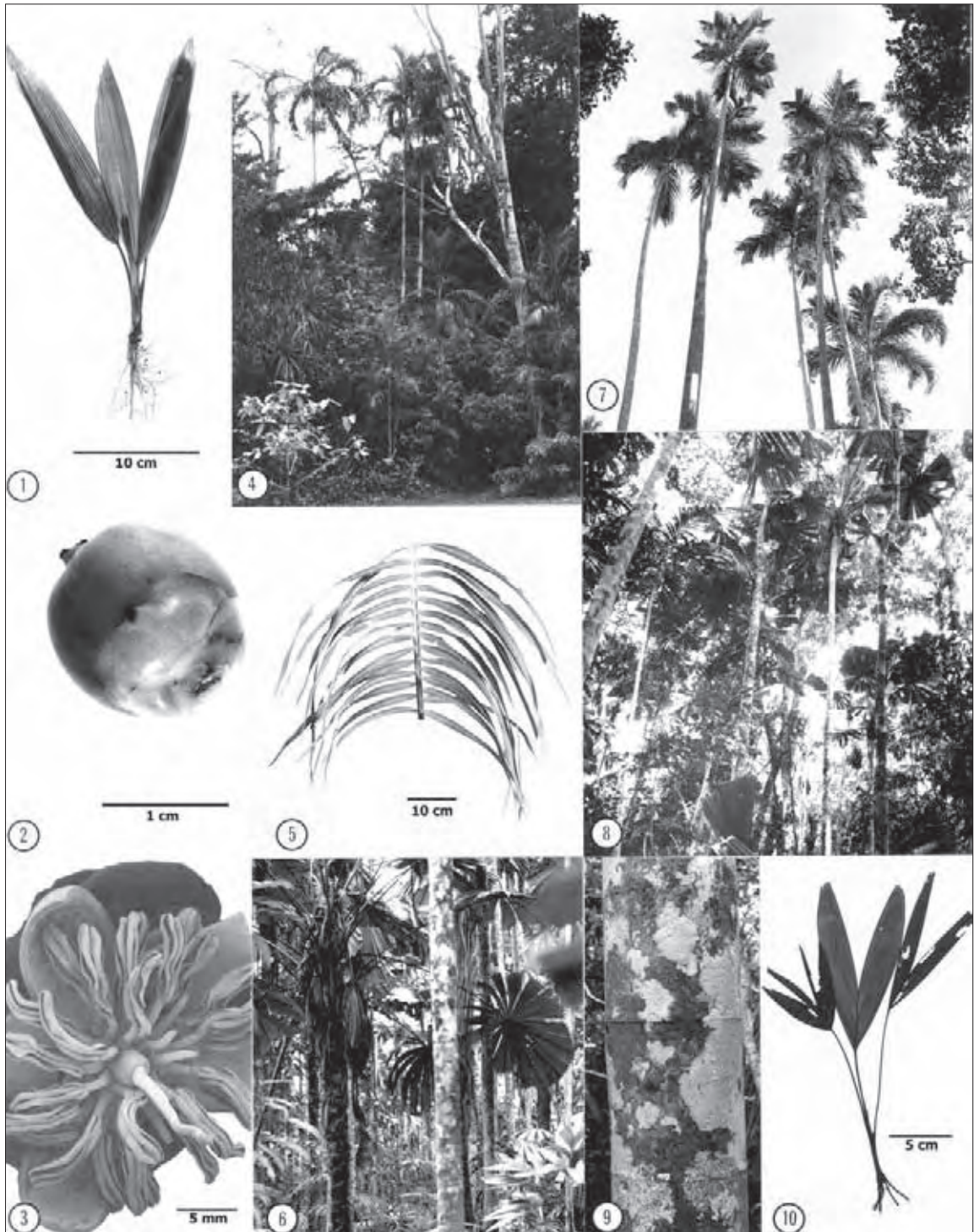
style. Female flowers lack stamens; they have 3 carpels united into a single ovary and mature later than the male flowers.

Fruits: Globular to ellipsoid, about 2 × 1.8 cm with a thin, smooth surface layer enclosing a fleshy mesocarp and a single seed. The 3 stigmas persist as lobes about 0.1 cm long on the end of the fruit, which is bright red at maturity.

Wood: No details available.

Climate: Altitudinal range: near sea level to 20 m; hottest/coldest month: 34°C/20°C; Frost incidence: low; Rainfall: 1550 mm per year, summer max.

Distinctive features: A feather-leaved palm with a smooth stem and compound inflorescences produced more or less continuously from below the crown; red fruits.



Palms: *Licuala ramsayi* (Lr), *Carpentaria acuminata* (Ca) 1. Seedling (Lr) 2. Fruit (Ca) 3. Male flower (Ca) (S.E.M.) 4. Trees (Ca), near Darwin, N.T. 5. Section of adult leaf (Ca) 6. Single palm (Lr), near Cape Tribulation, north Qld 7. Crowns (Ca), Humpty Doo, N.T. 8. Crowns (Lr), in stand at Little Pine Creek, near Gordonvale, Qld 9. Bark of palm stem (Ca) 10. Seedling (Ca)

Wedge Leaflet Fan Palm Hessian Hair Fan Palm

Licuala ramsayi (F. Muell.) Domin

Wedge leaflet fan palm is a medium-sized, single-stemmed palm up to 20 m tall, but mostly less than about 15 m. The stems are usually quite straight and slender and up to 0.2 m in diameter. The crown consists of large fan-shaped leaves.

This palm occurs in north-eastern Australia from the tip of Cape York Peninsula to near Ingham, mostly within 20 km of the coast. The species may possibly extend to Papua New Guinea around the Fly and Morehead Rivers.

Soil types vary from rather shallow clay loams to sandy clay loams on schists, granites or shallow volcanics and friable loams to humic gleys on alluvial soils. The species is slow growing and shade loving. It establishes itself under existing canopies, particularly along drainage lines, swamps, depressions and occasionally on more elevated slopes. In some rainforests, it forms almost pure secondary or tertiary understorey stands.

The species is cultivated by nurseries for ornamental shade plantings in tropical areas.

Related species: The genus ranges from Burma to the New Hebrides and has about 108 species. Most species are small. *L. ramsayi* is a giant in the genus and is the only species of *Licuala* in Australia.

Publication: *Beit. Fl. Pflanzeng. Aust.* 500 (1915). Type: Rockingham Bay, northern Queensland, Ed. P. Ramsay.

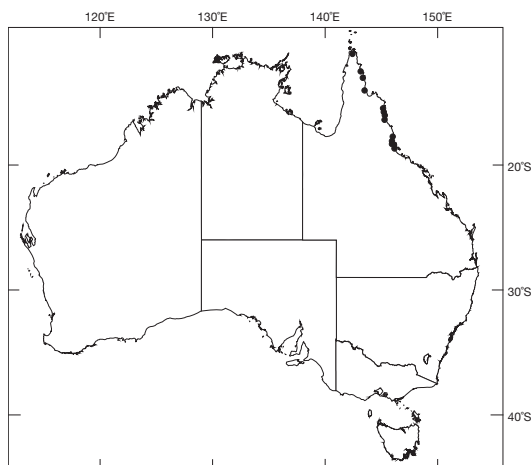
Names: Botanical—*Licuala*, after the name of one species in the language of people of Macassar; *ramsayi*, honours Ed. P. Ramsay the collector of the type. Common—in reference to the form of the leaf.

Stems: Dark brown to grey, smoothish, straight and of even diameter. Slight swelling at base, where numerous adventitious supporting roots may be present up to 20 cm above ground.

Leaves: Seedling—alternate (petioles spineless, to 4–10 cm long), undivided initially, lanceolate, cupped with edges downwards, 7–20 × 1–6.5 cm; venation parallel, 4–6 main veins in early leaves, increasing to about 10 before leaves divide and expand to become circular in outline. Adult—circular, on a petiole 125–250 cm long, 1.8–2.2 cm wide, 1.6–2 cm deep, with a few spines near the junction with leaf sheath; blade 130–185 cm diameter with a very short hastula on the upper surface and a midrib extending to the leaf margin or forking about 75 cm from base; leaf segments shiny dark green, reduplicate with 4–15 veins; leaf sheaths initially tubular, red-brown, fibrous, hessian-like, splitting as stem expands, with a few strands persisting around stems.

Inflorescences: Axillary panicles, 1 per leaf axis. Main rhachis 140–210 cm, elongating up to 260 cm in fruit, with tubular bracts; at mature fruit stage, these have truncate to acuminate toothed tips, often resembling a crown. Only 1 basal peduncular bract visible, 35–50 cm deep. Conspicuous hair or scurf lacking on bracts. Flowers cream, very small, bisexual. Calyx connate, truncate, corolla 3-fid, valvate, stamens 6 with connate filaments; ovaries 3, united by the common style.

Fruits: Globose, fleshy, orange or red when mature, with apical remnants of the style, 0.9–1.1 × 0.8–0.9 cm, pedicel about 0.3



× 0.2 cm. Seed about 0.9–1 × 0.6–0.7 cm, homogeneous white endosperm with brownish oval intrusion of testa.

Wood: No true wood. 'Woody' part of stem consists of numerous parallel vertical brown and black hard fibres or vascular bundles, i.e. bundles of fibres and vessels, which are resistant to crosscutting.

Climate: Altitudinal range: near sea level to 450 m; hottest/coldest month: 30–32°C/13–22°C; Frost incidence: low; Rainfall: 1600–4400 mm per year, summer max.

Distinctive features: Shiny green circular leaves with wedge-shaped compound segments and red-brown, fibrous, hessianlike leaf sheaths. May be confused with *Livistona*, but distal ends of simple and compound segments are much broader than their mid-portions. The groups of compound segments are divided to the base in *Licuala* but only about half way down in *Livistona*

Abbreviations

A.C.T.	Australian Capital Territory
<i>c.</i>	about, approximately
<i>cf.</i>	compare with
cal cm ⁻² day ⁻¹	calories per square centimetre per day (for intensity of solar radiation)
cm	centimetres
CSIRO	Commonwealth Scientific and Industrial Research Organisation
°C	degrees Celsius
dbh	diameter at breast height (1.3 m)
ha	hectares
kg m ⁻³	kilograms per cubic metre (for wood densities at 12 per cent moisture content)
km	kilometre
km ²	square kilometres
m	metres
mm	millimetres
N.S.W.	New South Wales
N.T.	Northern Territory
pers. comm.	personal communication
Qld	Queensland
q.v.	which see (Latin <i>quod vide</i>)
S.A.	South Australia
S.E.M.	scanning electron microscope
sp.	species (singular)
spp.	species (plural)
subsp.	subspecies
°S	degrees south latitude
Tas.	Tasmania
var.	a variety
Vic.	Victoria
W.A.	Western Australia

Glossary

acicular

Needle-shaped

acuminate

Gradually diminishing to a point

aeolian

Carried by wind

alluvium (*pl. -a*)

Soil deposited by water (*adj.* alluvial)

alternate (of leaves)

A spaced arrangement of leaves along a stem, i.e. adjacent leaves neither opposite one another nor whorled

amentum (or catkin)

A spike, generally flexible, of unisexual flowers which usually falls off entire from the plant after maturity

amplexicaul

Stem-clasping, as the base of a leaf embraces the stem

anastomose (of leaf or phyllode nerves)

United by running together irregularly to form a network

andesite

A dark grey rock consisting essentially of an acid plagioclase

anther

The portion of a stamen which contains the pollen in pollen sacs; located (usually) at the tip of the staminal filament

apiculum

A short and sharp but not stiff point, in which an organ may end

areolate

Marked out into small, usually angular, spaces

articulate

Jointed, not of continuous tissue; as in eucalypts when the style base is inserted into the roof of the ovary

aril

A fleshy attachment of a seed formed by the expansion of the funicle

asymmetrical

Lacking in symmetry

auricle (of leaves)

A small lobe; an appendage to the leaf at its base

auriferous

Rocks or gravel containing gold

axillary (inflorescence)

Borne in the upper angle between a stem and a leaf

back-cut face

Timber cut so that the wide face of the piece is tangential to the growth rings

basalt

Rock of volcanic origin

basionym

Former name since replaced by another, making use of the same stem or epithet, as a result of a change in position and/or rank of the taxon to which the name refers

beaked (of opercula)

Contracted at apex to form a distinct beak (*syn.* rostrate)

bentwork (of timber)

Wood that by its structure will tolerate bending into shapes

berry

Indehiscent, many-seeded, usually fleshy fruit

bipinnate (of leaves)

When both primary and secondary divisions of a leaf are pinnate

blaze

A slanting section through the bark of a tree exposed by removing a chip with an axe or knife

bole

The trunk or stem of a tree

borer, *Lyctus*

Larva of the family Lyctidae, commonly the species *Lyctus brunneus* Steph., which attacks starchy sapwood of some seasoned or partially seasoned, pored timbers. The adult beetle makes the flight hole. (*Syn.* powder-post borer)

borer, marine

A marine crustacean or mollusc that tunnels into timber submerged in salt or brackish water, e.g., *Limnoria*, *Bankia*, *Teredo*

bract

A much-reduced leaf; commonly associated with inflorescence structures or with resting buds. The usage here is with inflorescence structures unless otherwise qualified

bracteole

A leaf in the axil of which an inflorescence or single flower arises

brushwood

Refers to tree species of the rainforest; a term commonly used in New South Wales and Queensland

butt

The lowest portion of the stem of a tree, log, pole or post

buttress (of trees)

The plank-like growths of the trunk or roots in certain trees (usually rainforest species)

Cainozoic

A geological era (*see* Table 1)

calyx

The outer whorl of floral 'leaves', composed of free or united sepals (*adj.* calycine)

calyx tube

A tubular form of the calyx due to the union of the sepals. In eucalypts, the tissue surrounding the ovary or capsule has been erroneously called the calyx tube; this tissue is the expanded summit of the pedicel and is referred to here as the hypanthium

campanulate

Bell-shaped; applied to the corolla or, in the case of eucalypts, to the fruit

capsule

A dry dehiscent seed vessel. In eucalypts it is partially or wholly submerged in the hypanthium

carpel

A simple pistil, or element of a compound pistil, comprising ovary, style and stigma

cataphyll

The early leaf-forms of a plant or shoot

catkin

See amentum

chartaceous

Papery

ciliate

Fringed with hairs

cladding (of timber)

Boards used for covering timber structures

cladode

A stem, frequently flattened, adapted to perform the functions of a leaf

columella

The central axis of a fruit, especially that found in the cone of a conifer

community (of plants)

Any natural assemblage of plants

community (of leaves)

A leaf divided into separate blades

complex, simple (of rainforest structures)

Terms used by Webb (1968) to indicate species dominance in the upper tree layers; 'simple' implies one or a few species, 'complex' implies many

compound (of leaves)

Made up of several elements, i.e. several leaflets

concolorous

Uniform in tint; when applied to leaves it indicates a similar shade on both sides

cone

The woody fruit of a conifer, e.g. pine cone

conglomerate

Rock consisting of cemented fragments of other rocks of varying sizes

coppice

New sprouts arising from a lignotuber or stump, typically following loss of, or damage to, the foliage of a plant

cordate

Heart-shaped; applied to ovate leaves having the petiole at the broader and notched end

coriaceous

Leathery

corolla

The inner whorl of floral 'leaves', composed of free or united petals

corymb

A racemose inflorescence in which the lower flowers have longer pedicels than the upper ones, thus tending to bring them all to the same level

crenulate

Scalloped or toothed with small rounded notches on the margin of a leaf

crisped (of leaf hairs)

Irregularly waved and twisted, curled

cryptocotylar

Of germination or seedlings in which the cotyledons remain within the seedcoat (the reference point is the seedcoat rather than the soil level)

cuboid

Resembling a cube

cyme

An inflorescence in which the terminal flower opens first, subsequent flowers being produced by growth from lateral buds

deciduous

Shed periodically

decorticate

Shedding of bark from a tree

decurrent

The condition of the edges of sessile leaves when the flanges continue down the stem

decussate

The arrangement of leaves on a stem such that they are in pairs alternately at right angles

dehiscent

Splitting or rupturing at maturity, usually referring to the spontaneous opening of seed capsules when ripe

deltoid

Triangular in shape; delta-like

density (of wood)

Weight per unit volume usually expressed in kilograms per cubic metre. Because changes in moisture content of the wood affect its weight and volume it is necessary to specify the moisture condition at the time of testing

density, air-dry (of wood)

Density based on weight and volume of timber in equilibrium with atmospheric conditions. This is usually called the 12 per cent moisture content

density, basic (of wood)

Density based on oven-dry weight and green or maximum volume

digitate (of leaves)

A compound leaf in which all the leaflets are borne on the apex of the petiole; finger-like

dimidiate

Meaning halved, when only one side is fully developed; used to describe phyllode shape in some *Acacia* spp., lower margin more or less straight, upper margin curved, widest more or less at the middle

dioecious

With male and female flowers on different plants

disc

Band or ring of tissue between the ovary and the base of the stamens, e.g. in *Eucalyptus*, *Terminalia*

discolorous (of leaves)

When the two surfaces of a leaf are unlike in colour

distal

Remote from the place of attachment; the converse of proximal

distichous (of leaves)

Disposed in two vertical ranks; leaves arranged in two ranks on either side of the stem in the same plane

dolerite

A dark igneous rock

domatia

Modified blister-like projections on leaves, usually in the axils of veins (from Latin, a little house)

drip-tip (of leaves)

A long drawn-out leaf apex; a shape believed to assist watershed from leaves

drupe

A fruit where the pericarp is fleshy or leathery, containing a stone with a kernel

ecosystem

Ecological system

elliptic

Oval in outline, widest at the middle

emarginate

Having a notch, usually at the extremity; mostly refers to leaves

endemic (of plants)

Confined to a given region

endocarp (of fruits)

The inner layer of the pericarp

entire (of leaves)

With a continuous margin, i.e. not toothed, crenulate, etc.

epiphyte

A plant which grows on another, but not parasitically

excrecences

Outgrowths, enlargements, usually abnormal

exocarp (of fruits)

The outer layer of the pericarp

falcate

Sickle-shaped; used in reference to leaf shape

family

A group of allied genera

fern (of rainforest structures)

See vine, fern, moss

fiddleback (of wood)

Wavy pattern in arrangement of wood fibres (*see also* figure, wavy)

figure, wavy (of timber)

An arrangement of fibres etc. in the form of waves or undulations. When the undulations are large the figure is said to be wavy; when small and tending towards irregularity the figure is said to be curly; when very small and regular the figure is described as fiddleback

filament

The stalk of a stamen

fissile (of timber)

Easy to split

foliolate (of leaves)

Having leaflets

follicle

A fruit of one carpel, opening by a ventral suture to the side of which the seeds are attached

foot-stalk (of podocarp fruits)

Sterile scales which fuse and develop into a swollen, fleshy, brightly coloured edible receptacle on which the seed is borne

foveola (of leaves)

A small depression or pit, usually in the axils of leaf veins on the underside of leaves

framing timber

Timber used to form the basic structure of a building

funicle

A cord or thread which sometimes connects the ovule or seed to the placenta

gallery rainforest

Strips of rainforest bordering watercourses in areas of open forest, dependent on soil moisture to compensate for low annual or seasonal rainfall

genus

The collective name of a group of species possessing certain common characteristics by which they are distinguished from all others

glabrous

Bald, free from pubescence of any kind

glaucous

The colour blue-green

gneiss

Laminated rock of quartz, feldspar and mica

grain, interlocked (of timber)

A type of grain structure where the angles of the fibres change or reverse periodically in successive layers

grain, straight (of timber)

An arrangement in which fibres or other longitudinal elements follow a course parallel to the edges of the piece

granite

Igneous rock of granular texture formed principally by cemented quartz, orthoclase and mica

growth rings

Concentric rings seen on a cross-section of a log, due to differences in texture and colour of the wood elements, formed by differential summer and winter growth

gum vein (of wood)

A ribbon of gum or kino between growth rings which may be bridged radially at short intervals by wood tissue. Mainly in eucalypt timbers

gynophore

The structure that supports the female parts of the flower (the gynoecium)

habit

The growth-form of a tree

hardwood

Wood from trees classified botanically as angiosperms. The term does not denote the relative hardness of the wood, though it is sometimes used in this sense

head (inflorescence)

A compound inflorescence where the individual flowers are closely crowded together

heartwood

The innermost and oldest wood (inside the sapwood), no longer functional for water transport or food storage, often characterised by coloured deposits of resinous, phenolic and other compounds which are frequently associated with enhanced durability

hispid

Covered with rough hairs or bristles

holotype

A single herbarium specimen on which a species name is based

humus

Organic matter in soil formed from decomposition of plant and animal matter

hypanthium (pl. -ia)

Enlarged receptacle; in the case of eucalypts, the invaginated torus

hypocotyl

Plant axis between the cotyledons and the root

imparipinnate

A pinnate leaf with an odd terminal leaflet

indumentum

Any covering, as hairiness

inferior (ovary)

Applied to an ovary enclosed by a receptacle which bears the other floral parts above it

inflorescence

The flower-bearing portion of a plant including the flowers themselves

intergrade

Where two closely related species of contiguous distribution merge morphologically

internodes

Intervals of stem between any two nodes

intramarginal (vein)

Situated within the margin of the leaf, and near the edge

involucre

A ring of bracts surrounding several flowers or their supports

isotype

A duplicate of the holotype

joist

A piece of structural timber, generally rectangular in section and laid on edge; used to support the flooring or ceiling of a building

jugary (of glands)

A gland at the junction of a pair of pinnae on the rachis of a bipinnate leaf, as seen in some bipinnate species of *Acacia*

Jurassic

A geological period of the Mesozoic era (*see* Table 1)

juvenile (of leaves)

A term used to describe the characteristic leaves of young plants; especially when the form of such leaves is distinct from those of the mature plant

kino

A dark reddish exudate, rich in polyphenols (tannins), developed in the cambial region of eucalypts often as a result of injury; incorrectly called gum

krasnozems (of soils)

Term used by Stace *et al.* (1968) for essentially red to brown, deep friable strongly structured clay soils, showing very little profile development beyond the accumulation of organic matter in the A horizon. Krasnozems occur under generally humid conditions and develop from a wide range of parent materials: in cooler humid areas of Australia from basalts and in humid tropical areas from practically all but the most siliceous rocks. They correspond to a range of soils termed ferrosols by Isbell (1996)

lanceolate (of leaves)

Narrow and tapering at each end; lance-like; in modern usage the base is usually somewhat broadened, with the greatest breadth at about one-third from the base

laterite

A soil produced by a fluctuating watertable in a hot climate. It is characterised by concretionary ironstone occurring as gravel or as a solid mass on or near the surface and leached clay in the lower layers; usually infertile

leaflet

The blade or separate division of a compound leaf

lectotype

A plant specimen later chosen from a group of specimens, cited in the original description, in order to typify the species

legume (of fruits)

A seed-vessel that is one-celled, dehiscing by two valves; sometimes called a pod

lenticels

Minute pores or slits in young bark, similar in function to stomata on leaves

lignotuber

A woody structure, sometimes large, developed from swellings associated with leaf nodes at the base of the plant; commonly occurring in eucalypts but also in other genera. Lignotubers provide an important reservoir of buds and food that assist the plant to survive under adverse conditions, e.g. browsing, drought or fire

linear

Long and narrow, the sides parallel or nearly so

Lyctus

See borer, *Lyctus*

macrosporangium

The sac containing macrospores; in the case of conifers, the ovules

macrosporophyll

A modified leaf which bears the larger of two kinds of spores; in the case of conifers, the ovular scales

mallee (of Aboriginal origin)

A type of eucalypt in which several stems arise from an underground lignotuber

mallet (of Aboriginal origin, W.A.)

A slender, erect, tree-form eucalypt that lacks a lignotuber, regenerating from fire only via seed

marlock (of Aboriginal origin, W.A.)

A non-lignotuberous type of eucalypt that has a very short bole and bushy crown

medullary rays

Radial bands of soft tissue which produce figure in the timber of some broad-leaved trees

mesophyll, notophyll, microphyll, nanophyll (of rainforest structures from leaf sizes)

Refers to the lengths of leaves in rainforests, as used by Webb (1968) to subdivide structurally Australian rainforests. Leaves greater than 12.7 cm long are termed mesophyll, between 7.6 and 12.7 cm long are notophyll, between 2.5 and 7.6 cm long are microphyll and less than 2.5 cm long are nanophyll. As both latitude and altitude increase, leaf size generally decreases, with climate (and to a lesser extent soil fertility) having the greatest effect on leaf size. Tropical rainforest has a higher proportion of mesophyll to notophyll leaves compared with subtropical rainforest. Temperate rainforest has small leaves of notophyll, microphyll or nanophyll size

metamorphic (rock)

A rock whose constitution has undergone pronounced alteration. Such changes are generally effected by the combined action of pressure, heat and water, frequently resulting in a more compact and more highly crystalline condition of the rock

microphyll

See mesophyll, notophyll, microphyll, nanophyll

microsporangium

The sac containing microspores; in the case of conifers, the pollen

microsporophyll

A modified leaf which bears the smaller of two kinds of spores; in the case of conifers, the pollen scales

Minni Ritchi (of *Acacia* bark)

Reddish to coppery bark which sheds in short, narrow shavings, which curl back to form a 'hairy' appearance. Seen in about 20 species from *Acacia* section *Juliflorae*

moniliform

Like a string of beads

monoecious

With male and female flowers on the same plant

monsoon forest

See rainforest

montane

Of mountains

moss (of rainforest structures)

See vine, fern moss

mucronate

Possessing a short and straight point, as with some leaves

mudstone

An indurated shale formed by the consolidation of mud

muricate

Covered with short sharp prickles

nanophyll

See mesophyll, notophyll, microphyll, nanophyll

node

Thickenings where leaves are attached to the stem

notophyll

See mesophyll, notophyll, microphyll, nanophyll

obovate

Reversed ovate; the distal end broader

obtuse

Blunt or rounded at the end

open forest

As used by Specht *et al.* (1970) for Australian plant communities where the projective foliage cover of the vegetation is mid-dense (30–70 per cent). Open forests are divided into three forms which are categorised by the height of trees in the tallest stratum: tall open forest (includes many wet sclerophyll forests) with trees greater than 30 m; open forest (formerly dry sclerophyll forest) with trees 10–30 m; low open forest with trees 5–10 m

open shrubland

As used by Specht *et al.* (1970) for Australian plant communities where the projective foliage cover is very sparse (less than 10 per cent). Open shrublands are divided into two groups that are

dependent upon the height of shrubs in the tallest stratum: tall open shrubland with shrubs 2–8 m; low open shrubland with shrubs 0–2 m

open woodland

As used by Specht *et al.* (1970) for Australian plant communities where the projective foliage cover of the vegetation is very sparse (less than 10 per cent). Open woodlands are divided into three forms which are dependent upon the height of trees in the tallest stratum: tall open woodland with trees greater than 30 m; open woodland with trees 10–30 m; low open woodland with trees 5–10 m

operculum (pl. -a)

The lid or cap which covers the stamens in the bud of eucalypts

opposite (of leaves)

In pairs at a node on opposite sides of the stem

orthotropic

Assuming a vertical position (in reference to the direction of shoot growth)

ovary

That part of the pistil which contains the ovule(s); the immature fruit

ovate (of leaves)

Shaped like the longitudinal section of a hen's egg, the broader end basal; not to be confused with ovoid

ovoid

Egg-shaped solid

ovule

The structure containing the egg cell, which after fertilisation becomes the seed

palmate

Lobed or divided so that the sinuses point to the apex of the petiole

panelling (of timber)

Wide thin sheets of boards used for covering walls

panicle (of inflorescence)

A more or less elongated conical inflorescence, the axis dividing into branches that bear two or more flowers, the lower flowers opening first. In the eucalypts these inflorescences are leafless clusters of unit inflorescences terminating in a deciduous vegetative bud

paripinnate

Pinnate with an equal number of leaflets, i.e. without a terminal leaflet

pedicel

The stalk of an individual flower (or fruit)

peduncle

The stalk of an inflorescence

pellicle

A small skin-like structure

peltate (of leaves)

Attached to the stalk at a point inside the leaf margin

penninerved

Pinnately veined; the character of the leaf venation where the secondary veins are parallel to one another, diverging from the midrib

perianth

The collective term for the corolla and calyx of a flower

pericarp

The matured wall of an ovary

persistent (of bark)

Does not shed (decorticate) annually

petal

One unit of a corolla

petiole

The stalk of a leaf

petiolule

The stalk of a leaflet, as on a compound leaf

phanerophytes

One class of Raunkiaer's life forms: woody plants with perennating buds borne more than 25 cm above soil level. Includes trees and many shrubs. Taller trees, more than 8 m, are mega- (and meso-) phanerophytes

phyllode

A flattened leaf stalk performing the functions of, and modified to the form of, a leaf; as in many acacias

pinna (*pl.* -ae)

A primary division of a compound leaf; its leaflet

pinnate (of leaves)

With leaflets arranged on each side of a common rachis

pinnatifid

Pinnately cleft; leaf not divided entirely into separate leaflets

pistil

The seed-bearing organ of a flower, consisting of the ovary, style and stigma

placenta

The organ or wall which bears the ovules in an ovary

plagiotropic

Having a direction of growth oblique or horizontal

plumose

Like a feather

plumule

The primary leaf bud of an embryo

plywood

An assembled product of two or more wood plies bonded together with the direction of the grain in alternate plies usually at right angles

pneumatophore

A special root branch produced in large numbers by some vascular plants growing in tidal areas. Such a root projects into the air and contains well-developed intercellular systems of air spaces, in communication with the atmosphere through pores on the aerial portion; as in mangroves

pod

A fruit which when mature splits along two sides to release the contained seeds which are developed from a single row of ovules (*see also* legume)

podzol (of soils)

Term used by Stace *et al.* (1968) for acid soils of humid areas, usually sandy and with a white or very pale grey leached layer over an impervious layer (hardpan) and a more clayey subsoil. They correspond to a range of soils termed podosols by Isbell (1996)

podzolic (of soils)

Term used by Stace *et al.* (1968) for soils showing strongly differentiated profiles with a bleached subsurface horizon overlying a horizon which is rich in sesquioxides relative to those levels above and below it. Variations between types are associated with variations in the acidity of the profile, in the nature and quantity of the organic matter in the topsoil, and in the presence of ground water in the profile. They correspond to a range of soils termed chromosols, some dermosols, etc., by Isbell (1996)

pollen

The male element of flowers. It is produced in the anthers

porphyry

Igneous rock having a homogeneous base in which crystals of one or more minerals are disseminated

provenance

A particular geographic site of origin

pruinose

Covered with a waxy bloom, often giving an ashy, greyish or whitish appearance

pseudocarp (of *Terminalia* fruits)

A false fruit, in which parts other than the ovary assist in formation

pubescent

Clothed with soft hair or down

pulvinus (in *Acacia*)

Petiole-like structure at the base of the lamina of most phyllodinous acacias attaching the phyllode to the branchlet

pyriform

Pear-like in shape

quartzite

Metamorphosed sandstone

raceme (of inflorescence)

An inflorescence with all the flowers attached to the main axis by stalks of equal length, the youngest flowers at the top

radical

A small root; a primary root

rainforest

A closed community dominated by usually mesomorphic meso- or megaphanerophytes forming a deep, densely interlacing canopy in which lianes and epiphytes are often present, with mesomorphic subordinate strata of smaller trees, shrubs, ferns and herbs. Subforms:

Temperate rainforest. A rainforest community characterised by the usually poor development of lianes and epiphytes, the sparseness of the subordinate strata of smaller trees, shrubs, ferns and herbs (except in damp places) and the abundance of hygrophilous mosses and liverworts on the ground and the boles of the trees

Subtropical rainforest. A rainforest community characterised by an abundance of lianes and epiphytes, well-developed subordinate strata of smaller trees and shrubs, a poorly developed ground stratum of ferns and herbs (except in light breaks), and the comparative sparseness of hygrophilous mosses and liverworts on the ground and the boles of the trees

Tropical rainforest. A rainforest community similar to subtropical rainforest, but containing an additional uppermost stratum of tall trees (frequently figs) whose canopy is discontinuous; lianes are usually more prolific also

Monsoon rainforest. A rainforest community characterised by the dominance of deciduous species in the tree strata in which lianes and epiphytes are usually fairly common, moderately well-developed shrub and herbaceous strata, and the sparseness of hygrophilous mosses and liverworts on the ground and the boles of the trees

reticulate (of leaf veins/nerves)

With a network venation/nervation

rhachis (rachis)

The axis of an inflorescence or compound leaf

rheophyte

A plant with a riverine distribution

rhomboid

Quadrangular in shape with obtuse lateral angles

rim (of eucalypt fruits)

The narrow band or scar left by the loss of the operculum and stamens

riparian (of plants)

Frequenting river banks; growing by rivers or streams

rostrate

Contracted to form a distinct beak

rugose

Wrinkled, corrugated

samara

An indehiscent winged fruit

sandstone

A sedimentary rock formed of cemented sand, quartz etc.

sapwood

The most recently formed, outermost portion of the stem which is functional for the transport of water to the crown and for food (commonly starch) storage; it varies greatly in width and may represent 2–20 years growth; it is typically non-durable

scabrous

Rough with a covering of stiff hairs, scales or points

scantlings

Timber of rectangular or square cross-section and of dimensions used in construction

schist

A kind of foliated rock presenting layers of different minerals and splitting into thin irregular plates

scribbles (on eucalypt bark)

Zig-zag marks on the young bark made by insect larvae, e.g. on *Eucalyptus haemastoma*—the scribbles are the empty tunnels of the larvae of a small moth, *Ogmograptis scribula*, which burrow at the junction between the old and new season's bark before the old bark is shed

scurfy

Having scaly matter on the surface

sepal

One unit of a calyx

septifragal

Of dehiscence, where a capsule splits along the line of the septum or dividing tissue

sericate (sericeous)

Covered with fine, closely pressed, silky hairs

serrate

Beset with teeth on the margin; in reference to the character of the leaf margin; the teeth point towards the leaf tip

serrulate

With small teeth pointing towards the leaf tip

sessile

Without a stalk

setose

Bristly, beset with bristles

shrubland

As used by Specht *et al.* (1970) for Australian plant communities where the projective foliage cover is sparse (10–30 per cent). Shrublands are divided into two groups which are dependent upon the height of shrubs in the tallest stratum: tall shrubland with shrubs 2–8 m; low shrubland with shrubs 0–2 m

siliceous

Rocks containing abundant silicon dioxide, e.g. sandstone, quartz

simple (of leaves)

A leaf not divided into leaflets; with a petiole and blade having no joints or articulations

simple (of rainforest structures)

See complex, simple

sinus

A cavity, depression, recess or dilatation; a groove or indentation

skeletal (of soils)

Very shallow; parent bedrocks close to the surface

sleeper (of timber)

A strong piece of timber placed horizontally on the ground to support other members; hence railway sleepers etc.

softwood

Wood from trees classified botanically as gymnosperms (including conifers). The term does not denote the relative softness of the wood

spike

An indeterminate inflorescence with the individual flowers sessile on a common elongated axis, the youngest flowers at the top

sporangium

A sac in which the spores (pollen or ovules) are produced

sporophyll

A modified leaf, bearing spores

stamen

The pollen-bearing organ of a flower, consisting of an anther and its filament

staminal ring

In eucalypts, the narrow ring-like structure to which the stamens are attached

staminode

A sterile stamen, or a stamen without an anther; the latter being the particular case in eucalypts

stellate

Star-shaped, or radiating like the points of a star

stigma

That part of the style, usually the uppermost part, which receives the pollen

stipule

An appendage of a leaf on each side of the petiole, usually at the base of the petiole. Interpetiolar stipules are assumed to result from the fusion of two adjacent stipules attached to two opposite leaves

stocking

The rough bark on the lower trunk of an otherwise smooth-barked tree

stomate (*pl.* stomata)

A breathing pore in a leaf, usually on the outer surface, and surrounded by two guard-cells which control the size of the opening

striations

Grooves or ridges on a surface (i.e. of a leaf, fruit etc.)

style

The stalk surmounting the ovary and bearing the stigma

subtropical rainforest

See rainforest

superior (ovary)

Applied to an ovary when the floral parts are attached below the base of the ovary

suture

Line of junction of two parts immovably connected

syntype

Any of several cited specimens (or elements) a botanist has used in describing a new species, without selecting one definitive specimen (called the holotype); these specimens may not be designated by the author as such

tannin

An astringent chemical, available naturally in the bark (and sometimes in the wood) of different species of trees (especially *Acacia* and mangrove species); used in converting hide to leather

taxon (*pl.* taxa)

A taxonomic group of any rank, e.g. family, genus species etc.

temperate rainforest

See rainforest

tepal

A perianth segment which is sepaloid or petaloid

teredo

See borer, marine

terete

A cylindrical structure circular in transverse section

terminal (of inflorescence)

Situated at the end (of a branchlet etc.)

‘Terminales’ anther

The cuboid, obliquely held anther of some eucalypts, e.g. some boxes and ironbarks

termites

Insects (incorrectly called white ants) belonging to the order Isoptera, which are very active destroyers of woody material, especially in warmer areas of the world

ternate

In threes, consisting of threes

tessellated (of bark)

Surface marked into squares or oblong scales or blocks

texture (of wood)

The characteristic determined by the size and quality of the wood elements. May be fine, medium, coarse, uniform, uneven, smooth, harsh etc.

tomentum

A pubescence composed of matted woolly hairs

Triassic

A geological period of the Mesozoic era

trichome

A hairy epidermal structure; hairy

trifoliolate (leaf)

A compound leaf consisting of three leaflets

tropical rainforest

See rainforest

truncate

Shortened in shape, as though cut off at the end

trunk (of trees)

The stem of a tree

type (botanical)

An element (usually a herbarium specimen) on which the name of a taxon is based

umbel

An inflorescence in which the stalked flowers all arise from the same point

umbrageous (of crowns)

Widely spreading crown consisting of many branches and providing good shade. Usually woodland trees

uncinate (of leaves)

With a fine hook at the tip

undulate

Wavy, going alternately up and down; applied to leaf surfaces or margins

unit inflorescence (of eucalypts)

Individual flower cluster comprising the peduncle surmounted by 1 or more flower buds

urceolate

Urn-shaped or pitcher-shaped

valves

The split portions at the top of a ripe capsule

venation (of leaves)

The pattern formed by the veins

veneer (of timber)

A thin sheet of wood produced by slicing or peeling a log

verrucose

Warty

villous

Having a coating of long lax hairs

vine, fern, moss (of rainforest structures)

As used by Webb (1968) in his structural classification of Australian rainforests. The terms denote the presence of vines (robust woody lianes), ferns or mosses in rainforests; these are the primary divisions of the classification used by Webb. Vines are more a feature of tropical and subtropical rainforests, ferns of temperate rainforests, and mosses of cool-temperate rainforests

vine thicket (of rainforests)

As used by Webb (1968) in his structural classification of Australian rainforests. The term describes stunted vine forest vegetation in which the canopy closes at 3–9 m with mostly deciduous emergents (to 9–15 m tall). The term ‘forest’ is used where the canopy closes above 9 m. The height of the rainforest canopy is greatest at intermediate latitudes, decreasing towards the monsoonal north and the cooler south. At high altitudes the canopy is low

whorl

An arrangement of branches, leaves or floral parts in a circle around a common axis

woodland

As used by Specht *et al.* (1970) for Australian plant communities where the projective foliage cover of the vegetation is sparse (10–30 per cent). Woodlands are divided into three forms which are dependent upon the height of the trees in the tallest stratum: tall woodland with trees greater than 30 m; woodland with trees 10–30 m; low woodland with trees 5–10 m

xerophyte

A plant adapted to existence in a dry area

Illustrations of Botanical Terms Used in the Text

Leaf shapes



linear



oblong



lanceolate



oblanceolate



falcate



ovate



obovate



elliptic



rhomboid



deltoid



orbicular



reniform



cordate



palmatifid



palmate



imparipinnate



paripinnate



bipinnate



trifoliate



pinnate

Leaf apices



subulate



aristate



acuminate



mucronate



apiculate



acute



obtuse



emarginate

Leaf bases



cuneate



attenuate



obtuse



cordate



auriculate



hastate



sagittate



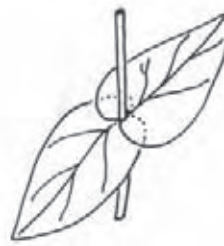
oblique



peltate



connate



amplexicaul



decurrent

Leaf edges



entire



crenate



dentate



serrate



serrulate



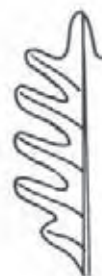
ciliate



lobed



pinnatifid



pinnatisect

Leaf venation



parallel



reticulate



penniveined



palmate

Cross-sections of leaf blades



plano-convex

upper
surface



incurved

upper
surface

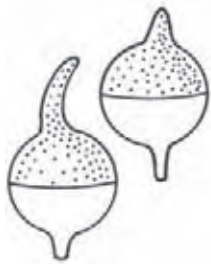


recurved

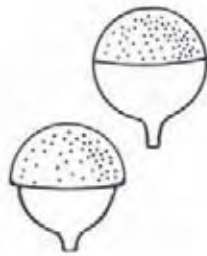


convolute

Floral bud opercula



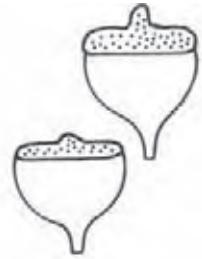
rostrate



hemispherical



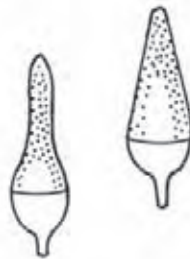
hemispherical-apiculate



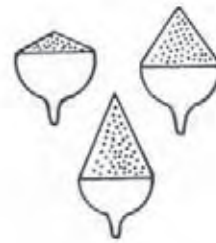
flattened



horn-shaped

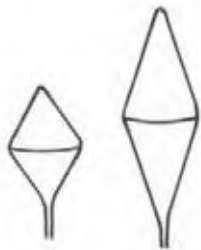


elongated



conical

Bud shapes



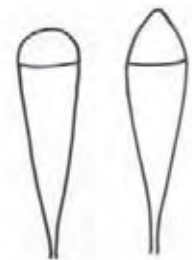
diamond-shaped or
double conic



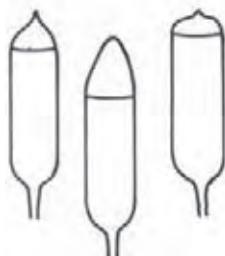
obovoid



ovoid



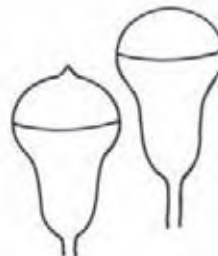
clavate



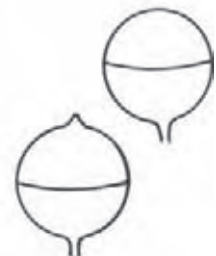
cylindrical



fusiform



pyriform



globular

Fruit shapes



obconical



pyriform



cylindrical



urceolate



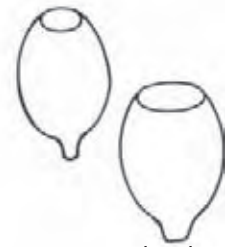
globular and
globular-truncate



hemispherical



campanulate



ovoid and
truncate-ovoid

Fruit discs



ascending



level



descending

Fruit valves



enclosed



rim-level



exserted

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